UNIVERSITY OF MARYLAND

AGRICULTURAL EXPERIMENT STATION

COLLEGE PARK, MARYLAND

TOWARD A MORE MODERN STATE

A

Survey of Agricultural Research
in Maryland

EIGHTY—THIRD ANNUAL REPORT

BULLETIN A-181   OCTOBER 1973

Volume No. 1

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AGRICULTURAL EXPERIMENT STATION

OCT. 1973

UNIVERSITY OF MARYLAND
AGRICULTURAL EXPERIMENT STATION
COLLEGE PARK, MD.

TO: The Governor of Maryland
The Board of Regents
and the President, University of Maryland

The Maryland Agricultural Experiment Station research program is dedicated to the advancement of agricultural sciences for the benefit of the citizens of the State. The proper interpretation and application of this knowledge will enhance production of crops, poultry, livestock, and livestock products. Perhaps of equal importance, this knowledge will enable improved utilization, management and conservation of land, water, air and energy resources. Most importantly, much of this new knowledge will contribute to improved quality of life for people whether their residence is rural, suburban or urban.

The major program thrust is to improve efficiency of production of crops, animals and animal products. Such enhancement may be from varieties or species which give higher yields or better nutritive quality, which may be more resistant to diseases or insects, or which result in improvement rather than degradation of land and water resources, or from systems which require less labor or eliminate drudgery and hazards.

Production oriented research is followed by processing or utilization research, and this includes nutritional values for, and acceptability of, new products by people. Thus, agricultural research is not just for farmers or agribusinesses; it is the basis of fulfillment of food and fiber needs for all people. Agricultural sciences are also the basis of management of home gardens, landscaped yards, and recreational areas of parks, forests and golf courses.

Production agriculture has historically been the Station's primary concern. However, in recent years much effort has been focused on waste management, economic policies, marketing systems, nutritional and consumer needs, aquatic biology and pollution abatement.

In recent months supplies and prices of food, agriculture's role in world trade, the balance of payments and the energy requirements for producing and processing of crops have been front page news. Study of the summaries in this report will show a high level of relevancy between our research and current critical needs.

It is with pleasure that I transmit this Eighty-third Report of the Maryland Agricultural Experiment Station established at the University of Maryland in accord with requirements of Acts of Congress, March 2, 1887. Reported here is research for the period July 1, 1969 - June 30, 1973, and a statement of receipts and disbursements for the same period.

Respectfully submitted,

R. L. Green
Acting Director

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Q-58-P	Quality Improvement of Canned Apple Slices and Sauce. R.C. Wiley, A.H. Thompson, and Graduate Assistants.

Q-58-T   Relationship of Pectinesterase Systems to Fruit and Vegetable Texture. R.C. Wiley and Graduate Assistants.

Q-58-U   Quality Maintenance, Measurement, and Control in the Marketing of Vegetables Including Potatoes. Amihud Kramer.

Q-58-V   Quality Maintance, Measurement, and Control in the Marketing of Vegetables Including Potatoes. L.E. Scott, J.C. Bouwkamp, and W.L. Harris (Agricultural Engineering).

Q-74   A Study of Regional Adaptation of Certain Vegetable Crops and Varieties in Maryland. C.W. Reynolds and F.D. Schales.

Q-77   Crop Management Studies with Vegetable Crops. C.W. Reynolds, J.D. Long, W.A. Matthews, F.D. Schales, F.C. Stark, and Graduate Assistants.

Q-77-B   Efficacy and Selectivity of Herbicides for Weed Control in Truck Crops. C.D. Altman, W.A. Matthews, C.E. Beste, F.D. Schales, G.J. Stadelbacher, D.A. Eiker, and F.C. Stark.

Q-77-C   Interrelations of Cultural Procedures to the Mechanical Harvesting of Tomatoes. F.F. Angell, F.C. Stark, and Graduate Assistants.

Q-77-D   Automation of Transportation and Processing of Tomatoes and Tomato Products. Amihud Kramer, F.F. Angell, B.A. Twigg, and Graduate Assistants.

Q-81   Cantaloupe Breeding and Selection. F.F. Angell.

Q-81-D   Tomato Breeding and Selection. F.F. Angell, F.C. Stark, A.L. Adams, and Graduate Assistants.

Q-81-E   *Asparagus officinalis* Breeding and Genetic Studies. J.C. Bouwkamp and Graduate Assistants.

Q-81-F   Breeding of Horticultural Crop Plants. J.C. Bouwkamp, C.B. Link, F.F. Angell, I.C. Haut, F.C. Stark, and Graduate Assistants.

Q-81-G   Genetics and Physiology of Sweet Corn Quality and Biological Efficiency. R.C. Wiley and Graduate Assistants.

Q-81-H   Discovery and Preservation of Valuable Plant Germ Plasm. F.C. Stark and J.C. Bouwkamp.

Q-83   The Dynamics and Energetics of the Soil - Plant - Atmosphere Continum. C.W. Reynolds, F.C. Stark, and Graduate Assistants.

Q-83-B   Study of Root Distribution and Density of Vegetable Crops. C.W. Reynolds, W.A. Matthews, and Graduate Assistant.

Q-84-A   Nutritional and Quality Stability of Fresh Foods by Gas Exchange. Amihud Kramer and Graduate Assistants.

Q-84-B   The Polyphenolase System in Relation to the Corrosion of Tin-Lined Containers. L.E. Scott, J.C. Bouwkamp, and Graduate Assistants.

QR-84-C   Simultaneous Fruit and Vegetable Drink and Concentrate Production, and Waste Water Purification by Directional Cooling. Amihud Kramer; A.M. Cowan (Agricultural Engineering); and K.H. Norris (USDA).

Q-85-A   Using Waste Formed in Vegetable and Cheese Production. Amihud Kramer, J.F. Mattick, E.C. Leffel, J.H. Axley, W.H. Kwee, and Graduate Assistants.

COLLEGE OF HUMAN ECOLOGY

Y-4   Utilization of Amino Acids from Proteins. Lillian C. Butler, Ann Thomas, and Graduate Assistant.

Y-5   Dehydro Reduced Ascorbic Acid Chlorophylls and Acids in Vegetables. Mary S. Eheart and Dale Queen.

Y-6   Ammonium Compounds on Retention of Chlorophylls and Ascorbic Acid in Green Vegetable Cookery. Mary S. Eheart.

Y-7   Nutrition Improvement in the Northeast Region. Lillian C. Butler.

Y-8   Consumer Needs of the Elderly. Rachel Dardis.

Y-9   Nutrition Improvement in the Northeast Region. Virginia P. Norton.
Y-10   Consumer, Market, and Laboratory Studies of Flame Resistant Textile Items. B.F. Smith and S.M. Spivak.

MARYLAND STATE COLLEGE

MSC-1   Socio-economic Potential of Rural Families. F.H. Forsyth and W.A. Lynk.
MSC TF   Occupational Choics and Its Determinants in the Agricultural Setting of the Lower
VNOL   Eastern Shore of Maryland. W.A. Lynk and W.T. Nelson.

DEPARTMENT OF POULTRY SCIENCE

M-58   Metabolic Studies on Poultry Pathogens. Mary S. Shorb, Pauline G. Lund, and Winifred R. Knuese.
M-61   Causes of Bruising in Transportation of Live Broilers from Farm to Processing Plant. N.V. Helbacka and D.E. Bigbee.
M-64   Embryonic and Postnatal Bone Growth in Chickens. E.F. Godfrey, C.S. Shaffner, W.O. Pollard, and Graduate Assistant.
M-66   Applied Broiler Nutrition Studies. O.P. Thomas, J.L. Nicholson, E.H. Bossard, J.H. Soares, Jr., and Graduate Assistant.
M-70   Inheritance of Lysine Utilization. E.F. Godfrey, W.O. Pollard, C.S. Shaffner, and Graduate Assistants.
M-71   Water Pick-up of Fresh-dressed Fryers and Texture, Flavor and Yield of Pressure-cooked Meat. E. Hoffmann and C. S. Shaffner.
M-100   Quality Retention in Poultry Meats. N.V. Helbacka, C.S. Shaffner, and D.E. Bigbee.
M-101   Influence of Slush-ice Chilling on the Quality of Processed Poultry. D.E. Bigbee and N.V. Helbacka.
M-102   Factors Influencing Broiler Carcass Yields and Microflora of Processed Broilers. D.E. Bigbee, C.S. Shaffner, P.A. Hanson, and Graduate Student.
M-103   Studies of the Yolk and Vitelline Membrane of the Egg as They Influence Egg Quality. J.L. Heath, G.L. Abbott, and E. Bouwkamp.
M-104   Microbial Assessment and Reduction Studies for Processed and Further Processed Broilers. C.J. Wabeck and D.E. Bigbee.
M-105   Light Influence Upon Processing Factors of Broilers Reared in Windowless Houses - Luminosity and Wavelength. C.J. Wabeck, J.L. Heath, and K.E. Felton (Agricultural Engineering).
M-106   Ammonia Intoxication in the Fowl and Its Influence on Metabolic Processes W.O. Pollard.
M-207   Study of Chicks Red Blood Cell Transketolase. C.F. Combs.
M-208   Use of Chick Bio-assay in Measuring Specific Amino Acid Availability. O.P. Thomas, Max Rubin, E. Bossard, and Graduate Assistant.
M-209   Effect of Protein Level and Amino Acid Balance on Voluntary Food Consumption. C.S. Shaffner, G.F. Combs, O.P. Thomas, E.H. Bossard, and Graduate Assistant.
M-210   Determination of Amino Acid Requirements of Growing Broiler Chicks and Laying Hens. O.P. Thomas, E.H. Bossard, J.H. Soares, Jr., Susan Welsh, and Graduate Assistants.
M-211   Increasing the Efficiency of Energy Metabolism in Fowl. R.D. Creek and Graduate Assistant.
M-212   Nutritional Improvement in the Northeast Region. Max Rubin and O.P. Thomas.
M-213   Interrelationship of Selenium and Cystine with Mercury. J.H. Soares, Jr., Susan Welsh, and O.P. Thomas.

| M-304 | Selection for Viability of Broiler Breeding Stock. C.S. Shaffner, E.F. Godfrey, E. Hoffmann, and J.L. Nicholson. |
| M-305 | Genetic Bases for Resistance to the Avian Leukosis Complex. C.S. Shaffner, W.O. Pollard; J.A. Newman (Veterinary Science). |

DEPARTMENT OF VETERINARY SCIENCE

D-52	Respiratory Diseases of Poultry. J.A. Newman, I.M. Moulthrop, and Carol Snedeker.
D-59	Fluorescent Antibody Technique in Respiratory Diseases of Poultry. J.A. Newman, W.W. Marquardt, R.B. Johnson, I.M. Moulthrop, and Carol Snedeker.
D-63	Study of Bovine Respiratory Diseases. S.B. Mohanty, M.G. Lillie, and Graduate Assistant.
D-64	Propagation of Avian Viruses in Tissue Culture. R.B. Johnson, J.A. Newman, and W.W. Marquardt.
D-68	Etiology and Control of Avian Leukosis. J.A. Newman, W.W. Marquardt, and Graduate Assistant.
D-69	Techniques for Eradicating Infectious Diseases of Poultry. J.A. Newman and W.W. Marquardt.
D-70	Equine Rhinopneumonitis (Equine Abortion Disease). S.K. Dutta and Laboratory Scientist.
D-71	Adequacy of Thermoregulatory Response to Cold Stress as a Factor in Decreased Disease Resistance. T.F. Albert, A.L. Ingling, and R.L. Schueler.

PROJECT REPORTS

AGRICULTURAL
and
RESOURCE ECONOMICS

COMPETITIVE POSITION OF THE NORTHEAST
IN MARKETING FRUITS AND VEGETABLES

This project was initiated on July 1, 1969. Several experiment stations throughout the Northeast cooperated in the regional research effort.

Regional objectives were:
1. Analyze various organizational and structural systems to determine the economic and technological advantages and disadvantages inherent in each system for marketing selected Northeast fruits and vegetables.
2. Evaluate economic and technological adequacy and efficiency of identified and potential organizational and structural systems for marketing selected Northeast fruits and vegetables.

Organizational and structural systems were to be examined at the processor, broker, wholesaler and retailer levels. Major areas of interest are: (1) Identification and quantification of economic and technological factors relevant to orderly and efficient marketing, and (2) Determination of economic and technological advantages and disadvantages inherent in each system and development of an "optimum" system.

The Maryland contribution centered on (1) A study of the effects of the economics of size on the marketing of processed snap beans and tomatoes in Maryland and the Northeast; and (2) The development and evaluation of "optimum" organizational and structural systems for marketing processed snap beans and tomatoes in Maryland and the Northeast under current and potential market conditions.

Change in Direction of Research (July 1, 1971 – June 30, 1973)
Changes in industry structure relative to size of firm and degree of integration made completion of the study as originally designed impossible. The original question, "Are there economics of size in selling processed snap beans and tomatoes in Maryland and in the Mid-Atlantic Area?" Could not be explored adequately in this case, because the direction of institutional change was anticipated, but not the aggregation of economic and other factors which controlled the speed of the change.

Therefore, the duration of the project will be spent in analyzing regional changes in food processing, wholesaling and retailing in Maryland, the Northeast and the United States from 1929–1967 and in projecting changes in these institutions to 1983. It is hoped that the results of this research will help owners and managers of business in these institutional areas to better anticipate structural changes in the future.

Project No. A-26-CC

MARKET ANALYSIS OF THE MARYLAND HORSE INDUSTRY

Horsemen are aware of the growth and development of the horse industry in Maryland, but many do not have a great deal of information on this developing market. Accurate and timely market information is necessary, if informed decisions are to be made by either individuals in the market, or those involved with the development of this industry.

The market base for today's horse industry is the recreation industry–an industry which is not only an economic fact of life, but predicted as a major growth industry for the 1970's. The pleasure horse makes up great deal of this market, but it also includes the race horse. Because of the continued acceptance of Maryland breeds by both Maryland and out-of-state buyers, the breeding of race horses is a major segment of the horse industry in the state.

All horse breeders ultimately receive market information through the market via prices paid for horses. However, whether breeding show, pleasure or race horses, information on the supply and demand forces in the industry which influence these prices is an essential requirement for the market breeder. Formal research had not been undertaken in this area. Research was needed to determine the characteristics of the market within which this industry operates.

Specifically, the objectives of the study are to:
1. Estimate the current size and marketing framework of the horse industry in Maryland.
2. Estimate the existing and potential market for pleasure horses in Maryland.
3. Estimate the size and characteristics of the market for Maryland bred race horses, and the expected growth in this market.

Progress to Date:
The development of a list of 90 percent of the horsemen in the state, containing detailed data on the number, age, sex, and breed of horses owned, was the first step completed in the analysis of the pleasure horse market. In addition to information on the scope of this market, this list provided the basis for a sample from which basic market information on the non-racing sectors of the industry is to be obtained. Questionnaires have been completed and tested. Meetings with USDA personnel have been held, and the basic requirements for an area survey determined, should an area frame survey appear to be necessary.

Historical data on the number of Maryland bred race horses which started in a recognized race, changes in the number of racing days and races, distribution of racing activity between breeds, and other information relative to the market for race horses has been obtained. An analysis was also initiated to determine the past, current, and expected demand for Maryland race horses. This data has been coded, key punched and put on magnetic tape, and a flexible data processing system has been designed which will permit incorporation of data from all segments of the industry.

Initial Results:
Data in Table 1 show the number of horses in Maryland reached their peak between 1910-1920 and declined every year until 1959. Since 1959, the only fact known about Maryland's horse population was that it was growing. Estimates were occasionally published. These ranged from 30,000 to 65,000 head. A CRS estimate in 1969 was 17,654 head.

Table 1. Horses & Mules on Maryland Farms

Year	Number
1900	166,505
1910	178,105
1920	173,962
1930	123,150
1940	104,697
1950	48,494
1959	15,259

Source: 1950, 1959, *Census of Agriculture*

In 1971 an attempt was made to vaccinate all horses in the state against Venezuelan Equine Encephalomyelitis. It was estimated about 90 percent were vaccinated. By coordinating and tabulating data obtained by state and federal veterinarians, a detailed breakdown of the number of horses was obtained. A questionnaire was mailed to a sample of these owners. Based on the vaccination data and sample returns, it is estimated that the state's equine population exceeds 53,000 head.

In Table 2, data are presented on the breed or type of horses, ponies, mules and donkeys vaccinated. As Table 2 indicates, the majority of horses from the pleasure horses breeds-horses used recreational activities. One reason is the continually increasing opportunity to show, use, or otherwise participate in some organized activity. Of individual breeds, the racing breeds shows the largest registration, primarily due to the fact that racing continues to grow both within the state, and nationally.

Table 2.   Number and Percent Vaccinated, by Breed or Type

Breed or Type	Number	Percent of Total
Grade (unregistered)	6,445	15.16
Thoroughbred	6,023	14.17
Quarter Horse	3,460	8.14
Standardbred	1,565	3.68
American Saddle Horse	1,305	3.07
Appaloosa	1,264	2.97
Arabian	840	1.98
Palomino	706	1.66
Tennessee Walker	511	1.20
Paint Stock	460	1.08
Morgan	336	.79
Hunter	137	.32
Other	4,978	11.71
Pony	13,045	30.69
Donkey	388	.91
Mule	216	.51
Omitted	829	1.95
Total	42,508	99.99 %

Source: Department of Agriculture and Resource Economics, University of Maryland.

Tentative Conclusions

While small operations were expected in the pleasure horse segment of the industry, initial analysis of the data obtained from the racing segment also suggests a structure dominated by the small operation. Data show that the bulk of these horsemen, whether breeder or racing stable, have relatively small operations. About 75 percent of the breeders have less than two foal producing mares. The degree to which the small operation dominates both the supply and demand side of this market has several implications which must be evaluated in terms of changes in the racing industry.

The demand for race horses is a function of the demand for racing. Data developed show that with population, disposable income, discretionary income and operating costs all rising, average daily attendance and pari-mutuel handle at Maryland's tracks are either relatively constant or declining. Total attendance and amount wagered are both increasing, but only because the number of racing days have increased. In short, the primary financial support for the industry is stagnant, but at the same time, the number of racing days and thus the number of horses needed are increasing. Given the stagnant support, the number of starters have increased faster than purses. Average earnings per horse have declined. Nevertheless, because this decline in revenue may be spread over more and more owners than anticipated, this suggests that the breeders market may continue strong for a longer period of time than would normally be the case.

While the structure of the pleasure horse industry has yet to be determined, it too is expected to be dominated by the small owner or breeder. Demand here is also increasing (at a rate which parallels or exceeds population growth). But because the supply response may be exceeding this shift in demand, without a floor provided by purses, market price may decline at a more rapid rate. Thus, in spite of the stagnation in the racing industry and the rapid, broad based growth in the demand for pleasure horses, the market for race horses is expected to continue to be the only broad based market where any significant economic return can be expected. There are certain exceptions, related primarily to different classes of horses within each segment of the industry.

These conclusions are tentative and will be re-evaluated as additional data is made available.

The Quarter Horse; this American breed originated in the colonial states and migrated west with the livestock industry. It has returned to the East coast and is one of the breeds responsible for the current increase in the equine population.

Data on the activities, characteristics, problems and demands of individuals and organizations owning and using these horses will be obtained. Combined with secondary data on population and income trends and the historical growth of the pleasure horse market, potential growth of this market will be re-evaluated. Analysis of functional relationships within the racing industry will be undertaken simultaneously. These analyses should shed additional light on the effects of possible changes in the industry on the markets for these horses.

Project No. A-26-CE

SELECTED INTERRELATIONSHIPS BETWEEN POULTRY MARKETING AND OTHER SECTORS OF THE ECONOMY

One of the major concerns of this study was the long run competitive position of the Delmarva poultry industry. Broiler firms in the Northeast tend to produce a bird which is heavier than the national average and which has a yellower skin color. This production practice is tied to the preferences of consumers in the Northeast.

However, the broiler industry in the Northeast is not insulated from the national market. There exists a serious and continuing threat of competition from broiler producers in the Southern states.

In order to evaluate the long run competitive position of the Delmarva broiler industry, a series of computer simulation models were developed. Each was developed to examine a specific series of questions. The first computer model used in this study used three supply regions: Maine, Delmarva and Georgia and three market areas: New York, Chicago and Baltimore-Washington, D. C. The results of the first model indicated that given existing consumer preferences and production practices by the industry, it is unlikely that Southern producers can displace Delmarva firms from their traditional markets. In addition, this study indicated that Delmarva firms should give serious consideration to penetrating the Baltimore-Washington, D. C. market.

The second computer simulation model was developed to investigate the possibility of Delmarva broiler producers attempting to penetrate markets where the marketing of lighter weight broilers predominates. The question of Delmarva firms producing lighter weight birds in order to compete in non-traditional markets has been raised periodically. (One of the earliest references is in a 1959 University of Maryland publication.)

By using a computer simulation model to evaluate alternative marketing strategies, it was determined that although a single firm could profitably exploit the idea of penetrating selected non-traditional markets, current economic conditions make it unprofitable for the Delmarva industry to try to market lighter weight birds in those markets which at this time are dominated by Southern broiler producers.

Project No. A-26-CA

ORGANIZATION OF THE WORLD'S AGRICULTURAL RESOURCES

The central theme of this project is to build up institutional profiles of several strategically located systems of agricultural resource organization. (An institutional profile is defined as the set of institutions used by and affecting the existing or potential productivity of a group of people who gain their principle livelihood through agriculture. Such institutions center on the resources used in agricultural production: land, labor, capital and management, but also include the institutions involved in marketing.)

During the past four years, research has concentrated on processing field data gathered in India, Chile and Spain.

A micro-analytic simulation program has been built which is designed to enable researchers to monitor the growth of a Hindu village through time, utilizing a computer system. Operation of this program is enabling us to look quantitatively at the economic impact of changes in population policy on this village. The study is still in progress. An earlier version of this program was operated successfully on the U.S. economy. The results of this study are reported by DePass in his Ph.D. thesis. An earlier study completed under this project, but reported on during this time period using a similar simulation model, suggested that in an East African farming community (in Uganda) per capita income (or agricultural productivity) would grow almost twice as fast if population were growing at 1.2 percent annually as it would if it were growing at the annual rate of 3.7 percent, (see illustration accompanying this report).

Per Capita Income (Hundreds of E A Shillings)
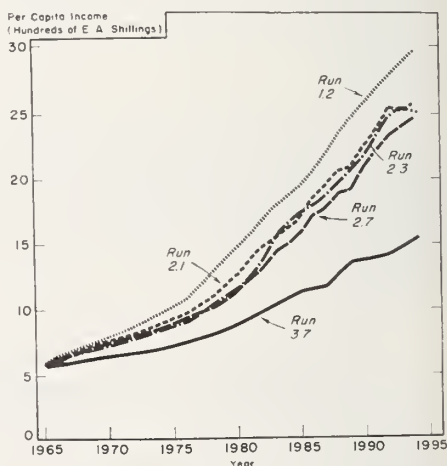
A micro-analytic simulation of an East African farming community suggested that, other things remaining the same, per capita income would grow almost twice as fast if population was growing at 1.2 per cent annually (Run 1.2) as it would if population were growing at the annual rate of 3.7 per cent (run 3.7).

The field work in Chile concerned the economic effect of Chilean agrarian reform on the private or non-reform sector. The effects of land reform were found to be positive in the non-reform sector. Results of this study are reported by Ringlien in his Ph.D. dissertation. The Chile field work has also resulted in a publication now in manuscript form on the structure of the hacienda in transition.

The field work in Spain concentrated on Iberian antecedents to the Latin American hacienda. The Iberian antecedents to the institutions, from which this important form of Latin American land tenure was synthesized, are found to have their roots in Roman culture. It found expression in the territory that is now Spain and Portugal. A publication resulting from this study is now in manuscript form.

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Recently, a study was undertaken to look at the relationship between population growth and changes in real per-capita local tax burdens in Maryland counties. Preliminary results of this study suggest strongly that rapid increases in population in Maryland counties result in substantial increases in the real per-capita local tax burden.

Project No. A-18-AX

OPTIMIZING RETURNS TO RESOURCES ON THE EASTERN SHORE OF MARYLAND

During the last two decades, the percentage rate of population growth in the nine counties composing the Eastern Shore of Maryland was about ½ of the rate of growth for the remainder of the state. The land area of the nine-county region includes 3,393 square miles, about 34.3 percent of the total land area of the state. Total population in 1970 was 258,329, or 6.6 percent of that of the state. The average density, people per square mile, of the Eastern Shore was 76.1, while that of the remainder of the state was 563.9 including Baltimore City and 429.6 excluding Baltimore City.

Historically, agriculture, forestry, fisheries and related industries represented the most important economic activities and source of income of the Eastern Shore residents. However, similar to changes in other parts of the state, as well as and the nation, these industires, as a source of employment and income, have not been advancing relative to other industries. Agriculture on the Eastern Shore has been influenced by the same economic, social and technical changes as that of the remainder of the state. However, competition for land, and to a certain extent labor, for other uses and types of employment has not been quite as intense. In 1940, about 2/3 of the total land of both the Eastern Shore and the Western Shore was in farms. By the end of the 1960's, 52.4 percent of the land on the Eastern Shore remained in farms, while only 39.6 percent of the land of the Western Shore was in farms.

Per capita incomes of Eastern Shore residents in 1970 was about 3/4 that of other Maryland residents, (Table 1). However, unlike the remainder of Maryland, the per capita incomes of farm residents of the Eastern Shore was comparable to that of urban residents of the same region.

Table 1.   **Per Capita Incomes According to Place of Residence and Geographic Region, Maryland 1969.**

		Place of residence			
			Rural		
Region	All	Urban	All	Non-farm	Farm
Maryland	3,540	3,683	3,073	3,053	3,226
Western Shore	3,597	3,698	3,180	3,160	3,354
Eastern Shore	2,733	2,881	2,694	2,663	2,886

In 1950, more than 1/3 of the people employed on the Eastern Shore worked in farms, forests or fisheries, slightly less than 1/5 were in manufacturing, slightly less than 1/5 were in trade establishments, and about 15 percent in the service industires, (Figure 1). By 1970, employment in farms, forests and fishery industries declined to 16 percent, manufacturing increased to almost 25 percent, trade increased slightly, and services and other increased to about 20 percent each. Projections to 1980 indicate that employment in farms, forests and fisheries will decline slightly, manufacturing will decline slightly and trade and services will increase further.

Total value of farm output of the Eastern Shore measured in current dollars increased about 140 percent over the last two decades, while that of the Western Shore increased only 50 percent,

(Figure 2). This averages to about seven percent annually on the Eastern Shore and about 2.5 percent annually on the Western Shore. When adjusted for changes in prices, farm output in Maryland increased about 2.3 percent annually, while that of the United States as a whole increased at an average annual rate of 1.5 percent over the last two decades.

Major adjustments made on Eastern Shore farms over the last two decades included (1) A decrease in the number of farms, (2) Increased size and output per farm, (3) The use of considerably less labor on farms, (4) Increased mechanization, (5) The use of slightly less land in farms, (6) Increased numbers of broilers produced, (7) Slight reductions in the output of dairy products, (8) Less acreages devoted to vegetable production and (9) More acreages devoted to corn and soybeans.

Corn and soybean acreages increased from about 45 percent of total harvested acreages in 1949 to about 65 percent in 1969. Changes in crop acreages resulted from difficulties of obtaining adequate hired labor, rising farm wage rates and the ability to mechanize production on grain farms which was not possible in vegetable production.

Factors which represented obstacles to increasing farm resource earnings as output per farm increased revealed, in analyses of alternative adjustment opportunities, varied according to size and type of farm. Rising real estate prices and increased investments in machinery influenced prospective earnings on cash grain farms, one of the three types of farms found to be increasing in numbers. Rising investments for construction of poultry houses and equipment costs without comparable product prices was a problem on poultry farms. Rising land prices and increased difficulty of obtaining satisfactory labor supplies were deterrents to expansion in the number and size of dairy farms.

A short time adjustment to overcome rising land prices is to rent more land rather than to attempt complete ownership of all land operated.
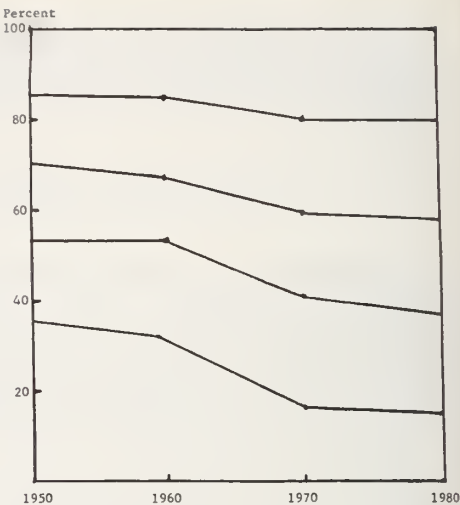
Project No. A-18-BA

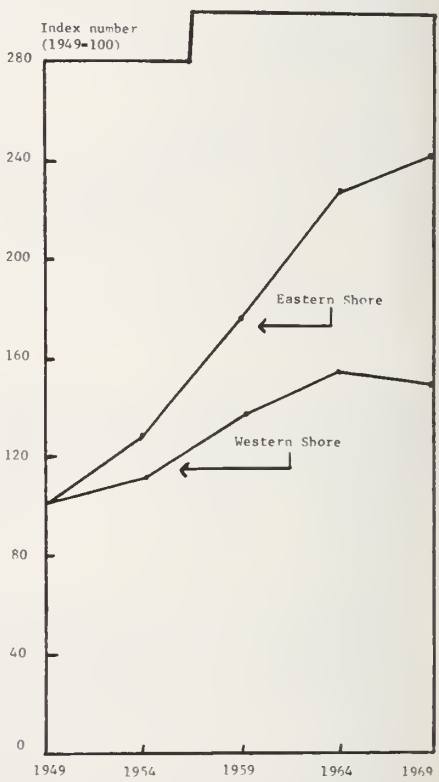Figure 1. Industry Distribution of Employment, 1950, 1960, 1970 and Estimated 1980.

Figure 2   Change in Farm Output By Regions, Maryland 1949-1969.

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EXTENSION OF UNEMPLOYMENT INSURANCE
TO MARYLAND AGRICULTURE

Background. Since the initiation of unemployment insurance programs in the United States in 1935, almost all states have excluded farm workers, among certain other segments of the work force, from coverage. Recently there has been growing interest in extending coverage to agriculture. In 1969-70, the Ninety-First Congress considered, but did not pass, legislation which would have extended coverage to agricultural employment. In taking this action, the Congress made a specific request that research be undertaken to provide information on groups now excluded under the unemployment insurance system, with "first attention to agricultural labor."

Objectives. The general objectives of the project were to: (1) Determine specific aspects of the economic impact of extending unemployment insurance coverage to farm workers in Maryland; (2) Identify and discuss various issues related to the extension of coverage to agriculture.

Procedures. The study was part of a regional project involving parallel studies in 14 other states. The regional technical committee, made up of all participating states, established standardized procedures for conducting the study and developed the questionnaires used.

The basic data for the study came from two sample surveys: A mail survey of 763 employers of hired agricultural labor and personal interviews with a sample of 435 hired farm workers. Sample values were expanded to get population estimates for selected variables.

Findings. A number of impact variables which measured various dimensions of the impact of coverage on the state were considered from the standpoint of five provisions. These provisions were selected on the basis of their importance in past, present, and projected future Maryland and national legislation. The most inclusive provision considered was universal coverage, which would cover all farms hiring one or more workers at anytime. This is the provision specified by Maryland law for all non-farm employers currently covered in Maryland. The most exclusive provision considered was one which would cover only those farms hiring eight or more workers in 26 or more weeks.

The estimates for each impact variable under all five coverage provisions follow. These estimates were also integrated with secondary data and analyzed with respect to the following issues:

1. Influence of long run trends in Maryland agriculture.
2. How inclusive should agricultural coverage be?
3. Impact of agricultural coverage on current state UI program.
4. Impact of coverage on costs of production for farmers.
5. Extent of record keeping required by farmers.
6. Effect on agriculture's competitive position in the labor market.
7. Effect on labor force participation and work incentive.
8. Impact on the economic welfare of workers.
9. Impact on welfare expenditures and caseload.
10. Extent of benefits received by racial minorities.

Table 1. Possible Approaches to Oyster Shucking

Energy form	Procedure	Preliminary result
acceleration	tumbling	gaping, meat damage
acceleration	centrifuge	some gaping, shell and meat damage
acceleration	dropping on hard surface	some gaping, shell and meat damage
acceleration	vibration	limited gaping or no effect
shock waves	fire crackers	limited gaping
shock waves	gas explosion in air	no effect
shock waves	mechanically generated	gaping, meat damage, occasional shell collapse
chemical	acids	no effect
chemical	carbon dioxide	no effect
chemical	osmotic dehydration	no effect on hinge
chemical	sodium bicarbonate	no effect
mechanical	hammer	shell damage
mechanical	hand opening devices	slow and high labor requirement
mechanical	mechanical tool	shell shattered
mechanical	impact loads-pendulum	shell shattered
mechanical	impact loads impact wrench	shell shattered
mechanical	cement drill	shell and meat damage
mechanical	shear-hydraulic cups	meat damage in 10-20 percent of oysters
mechanical	shear-stepped blocks	shell shattered
mechanical	piercing-chisel shaped tool	shell damage
mechanical	shear-wringer	meat crushed
mechanical	centering device	insufficient centering
mechanical	piercing-conical points	used for severing oyster hinge
mechanical	multiple points	shell breakage
mechanical	cutting shell	modified form used
mechanical	grinding shell	slow and appeared impractical
mechanical	wire brush	meat damage
mechanical	squeezing hinge	shell damage
mechanical	bone saw	slow and caused meat damage
vacuum	oyster in vacuum	no effect
vacuum	drying	no effect
vacuum	pulling valves apart	could not make seal with exterior of shell
pressure	high pressure chamber	no effect
heat	water bath	no effect on cooked meat
heat	propane flame	meat partially cooked
heat	alcohol flame	meat partially cooked
heat	acetylene flame	meat partially cooked
heat	carbon arc	meat burned and shell melted
heat	water shelded flame	ineffective
heat	visible light	effective when muscle spot located from shell exterior
heat and radiation	ultraviolet light	no effect
heat	infrared radiant	very good with proper precautions to prevent partial cooking
freezing	slow freeze	partially effective
freezing	alcohol-dry ice	effective most of time
freezing	direct expansion of freon	effective most of time

DEVELOPMENT OF A MANAGEMENT INFORMATION
SYSTEM FOR FEED MANUFACTURES

The purpose of this research project was to improve the competitive position of Delmarva broiler producers. A major portion of the cost of producing broilers is the cost of feed. Through the introduction of least cost blending of rations, using linear programming, dramatic reductions in the cost of feed have been achieved.

However, the current use of linear programming by the industry does not fully exploit the benefits of this management aid. This project explored the use of linear programming to blend several feeds for several time periods simultaneously in order to use scarce and/or high priced feed ingredients in the most efficient manner possible.

The major obstacle to more effective use of linear programming for feed formulation is the lack of computer programs that will simplify the data input and the form of the solution that multiple feed problems generate. Although this study was able to demonstrate the economic benefits that can be obtained by determining the least cost solution for several feeds simultaneously, the complexity of the problem and its solution indicates that relatively few firms will be able, at this time, to exploit the potential gains that exist. However, within a few years, commercial computer codes will be able to bridge the gap, thereby enabling broiler firms to use this information.

Project No. A-26-CD

ECONOMIC ANALYSIS OF ALTERNATIVE FORMS OF VERTICAL
COORDINATION IN THE LIVESTOCK—MEAT INDUSTRY OF MARYLAND

This project is part of the regional project, SM 41. The initial work performed was to obtain survey data from packers, order buyers, feeders, and auctions with respect to animal sources, market outlets, and types of vertical coordination between market channels. These data were used in two regional manuscripts now being prepared for final review: (1) The South's Hog-Pork Industry and Vertical Coordination (2) Vertical Coordination of Beef in the South—Nature of Different Systems.

A master's thesis was completed in 1971 on Labor Productivity Improvement of Beef Farms in Western Maryland. The study showed that the market supply of beef could be increased and productivity of labor improved in Western Maryland by feeding out groups of steers or combining feeding operations with good high quality cow-calf enterprises. A manuscript for a publication is being prepared.

A Ph.D. thesis entitled "An Economic Analysis of the Effects of Optimizing Hog Shipment Patterns and Market Structure on the Efficiency of a Country Marketing System" was completed in 1972. A publication from this thesis is pending. The findings in this study indicate the resources of the swine industry are not being used in the most efficient manner, as indicated in the attached table. A potential exists for generating substantial savings in transportation costs by optimizing the daily distribution of hogs from country markets to slaughter plants. The study points up needed adjustments in the use of industry resources to achieve economic efficiency.

Data is now being assembled in 1973 for a publication on Livestock Marketing and Slaughter Trends in Maryland. Trends will be shown by counties and will be helpful in program planning operations for the livestock sector.

Project No. A-26-CG

ECONOMIC ANALYSIS OF THE IMPACT OF POLLUTION CONTROL ON POULTRY AND EGGS IN THE NORTHEAST

The poultry and egg industries are a dynamic part of the agricultural sector of the Northeast. In many areas of the region, these industries remain viable despite rising costs, population pressure on land and alternatives provided by the dominant non-agricultural economy. These industries continue to thrive, because they adopt new technology rapidly and innovate continuously. Consumers benefit by having steady supplies of good quality products at prices favorable to those for other protein sources.

Public concern with environmental quality has become an issue of increasing importance. The passage of the National Environmental Policy Act of 1969 and the Water Quality Improvement Act of 1970 by Congress and the establishment of the Environmental Protection Agency by the Executive are indicative of the urgency surrounding efforts at the federal level to improve the environment. States and local levels of government are also active in environmental improvement efforts. It is certain that more stringent regulations will be imposed on all pollution-causing activities. Thus, the poultry and egg industries, along with other agricultural and non-agricultural industries, now face a new challenge.

This study is designed to identify those areas of pollution that will cause the greatest concern to environmentalists and impose the greatest hardship on the Maryland broiler industry to eradicate. Special emphasis is being placed on the problems of water pollution. The primary purpose of this study is to estimate the costs of environmental improvement before regulations are established in an effort to balance the economic and ecological needs of Maryland.

Project No. A-26-CH

"AN ECONOMIC STUDY OF AGRICULTURAL LABOR IN MARYLAND AND THE NORTHEASTERN STATES"

There has been a rapid rise in off-farm employment opportunities, off-farm wage rates and annual labor earnings potentials in recent years. This has placed great pressures on farm business managers using self-employed family labor and hired labor to increase technical farm labor productivity. The coming decade will witness an even sharper rise in wages for farm workers. State and federal levels of minimum wages for agricultural workers will rise to even higher levels. Technical labor productivity of farm workers will increase when complemented by the most appropriate non-human capital and land resources.

Maryland poultrymen now produce increasing quantities of broilers using less on-farm direct labor inputs. Labor productivity on broiler and other poultry farms has increased as a result of fewer man-hours per acre and per animal as well as by increased production per acre and per animal. Farm and farmstead mechanization have played a major role in reducing direct labor inputs in recent years. These increases in labor productivity per man-hour have helped to offset the higher wage rates per hour, resulting in lower labor costs per unit of output.

Broiler and turkey meat production have been affected the most by the long-term improvement in labor productivity in animal production (Table 1). The major factor in broiler production has been the increased number of broilers handled per man per lot when automatic watering and feeding equipment is used. More broiler production cycles can be completed within a one year period. In the 1930's, only two or three lots and a maximum of four lots per year was typical in Delmarva. Now, with improved rate of gain and feed efficiency, broiler growers can feed out five or six lots per year. Less labor is needed per 100 pounds live-weight of broiler and turkey meat than beef and pork. This advantage is expected to be maintained in the next decade.

Table 1. Estimated total and per hundredweight annual transfer costs for the existing and optimum market structures, by type of costs

Type of costs	Existing market structure		Optimum market structure		Increase (+) or Decrease (−)	
	Total costs	Costs per cwt.	Total costs	Costs per cwt.	Total costs	Costs per cwt.
Inbound transportation	$ 0 1,451,761	$ 0	$ 193,073	$ .0469	+$193,073	+$ .0469
Market operating	1,451,761	.3527	1,231,592	.2992	− 220,169	− .0535
Outbound transportation	1,828,712	.4442	1,775,906	.4314	− 52,806	− .0128
Total	$3,280,473	$ .7969	$3,200,571	$ .7775	−$ 79,902	−$ .0194

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Egg production is rapidly being consolidated into fewer operating units with larger numbers of hens per man and higher rates of egg production annually per hen. This combination of forces has already caused a major restructuring of the egg production and distribution industry. Their goal is to further improve labor productivity through the adoption of improved buildings and labor-saving equipment such as mechanized watering and feeding facilities. Many labor-saving improvements have been adopted in egg gathering, sorting, cleaning and packaging. Major labor productivity gains will continue to be made in the poultry production and distribution process in the future.

The research analyses on agricultural labor productivity help Maryland poultrymen to become more competitive with other production areas by reducing costs of production per unit of output and increasing *total annual returns* to labor and management resources. This work will help to improve the profitability of the poultry industry in Maryland and on the Delmarva Peninsula.

Project No. A-18-BC

POTENTIAL INCREASES IN AGGREGATE AGRICULTURAL LABOR PRODUCTIVITY IN TURKEY AND MOROCCO THROUGH INCREASED CAPITAL EXPENDITURES IN THE LIVESTOCK INDUSTRY"

This study was conducted in two countries, Turkey and Morocco. Both countries are heavily oriented toward agricultural economic activities in terms of production and employment of the domestic labor force. The study was initially approved and funded in 1967. The field work was conducted in 1968 by Mr. Omar and in 1969 by Dr. Wysong.

The Turkish Dairy Study
This study was concerned with methods of improving total and per worker labor productivity on individual farms and within processing and distribution firms through the expansion of capital inputs in the milk and meat production and distribution sector of the Turkish economy.

The 25 dairy farm businesses studied in 1968 and 1969 in Istanbul Province, Turkey had labor forces which ranged in size from one to nine and one-half full-time worker equivalents per farm.

The average total land area per farm for all farms studied was 76 decerts. The average number of cows on the sample of 25 dairy farms was 12 cows per farm. There was some tendency for cows per farm to increase with size of farm labor force. This tendency was most evident between farms with fewer than three full-time workers and those with three or more workers.

The average labor intensity as measured by number of cows per worker for the group of 25 farms was an average of 3.5 cows per worker. These farm businesses had an average annual milk production of 2,842 liters per cow.

The average number of cows per worker increased from an average minimum of one cow per worker to an average maximum of seven cows per worker as the size of milk cow herd increased from fewer than five cows to the maximum of 65 cows. A herd size of 20 to 30 milk cows was generally large enough to fully utilize the typical farm labor force in productive employment using labor-intensive manual production techniques.

Five different methods of milk marketing were observed and studied in Istanbul Province. These were: (1) Selling to dairy processing plants (2) Selling to wholesalers (3) Selling through cooperatives (4) Retail routes in the city of Istanbul and (5) Selling locally.

Average productivity per worker is only partially related, if at all, to the number of workers per farm. However, overhead capital and management resources are frequently more fully and

effectively utilized on farms with three or more workers which have larger volumes of production over which to spread the fixed cost elements of the business firm. The average number of workers per farm was slightly over three man-equivalents on this sample of 25 Turkish dairy farms in Istanbul Province, Turkey. The potential exists to use increased quantities and qualities of overhead capital and management more efficiently in the future by expanding output per farm, while holding labor force per farm operating unit constant. More non-labor resources used per unit of labor resource employed in the business and resource reorganization generally will result in higher average and marginal rates of output for given quantities of labor units.

Reorganization of milk cows into larger milking and feeding operating units would help to improve human resource productivity in these types of farm activities. This could be done with relatively small additions of capital for buildings or equipment. This type of resource—mix recombination and reorganization--has occurred in Maryland and other U.S. dairy production areas since the pre-World War II period.

Due to the relatively small size of sample, further field research of other Turkish dairy farms needs to be conducted. Also, more production areas within Turkey and more countries of the world could profitably be included in order to make spatial comparisons of human resource productivity around the globe over time.

The Moroccan Dairy Study

The project was concerned with the potential for increased aggregate agricultural labor productivity in Morocco through increased capital expenditures in the dairy and livestock industries.

Moroccan dairy farms varied widely in size of cow herd. Generally, they tended to be quite small in 1968 and 1969.

The number of cows on the 77 individual farms studied was 13.4. This average herd size was similar to that found in Turkey in 1968. Likewise, it was similar to that found in Maryland, New York, Wisconsin and other dairy areas in the pre-World War II period, 1935-39 and earlier.

The number of cows on the 77 individual farms studied was 13.4 cows per farm. This average herd size was similar to that found in Turkey in 1968. Likewise, it was similar to that found in Maryland, New York, Wisconsin and other dairy areas in the pre-World War II period, 1935-39 and earlier.

The size of milk cow herds studied in Morocco ranged from a high of 160 cows on the largest farm to a herd consisting of only one milk cow per farm. Farms with extremely small numbers of milk cows prohibit high levels of farm worker productivity, unless other animal or crop enterprises are important types of within farm production and sale. Part time labor resource employment off the farm reduces the importance of large numbers of cows per herd and per farm in achieving full use of human resources.

Moroccan dairy farms typically utilize large quantities of family and hired labor relative to land and capital resources and volume of output from farms. This results in part from the fact that in Morocco substantial quantities of rural labor are available at relatively low costs. Also, crop production activity generally is the primary enterprise on farms with dairy cows. Therefore, livestock and dairy cows tend to be supplementary or complementary to crop production. They are fed many waste crop residues which would have little other value if not used by dairy animals to make milk and meat.

The number of hired workers increased from an average of 1.5 man-equivalants to 26.1 man-equivalants with increased size of cow herd. However, this increase in hired man-equivalants per farm resulted in the intensive use of family labor on the small farms and the extensive use of family workers on the large farms.

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The average land area operated per farm increased with increased size of dairy herd. The average land operated for all farms studied was 77.8 hectares (one hectare = 2.47 acres).

The highest average level of the land operated per man-equivalent ratio was 8.4 hectares per man on the seven largest dairy farms in the study.

The larger farms, in terms of crop-land area and numbers of milk cows, tended to utilize human labor resources more efficiently in both crop and livestock production activities than smaller farms, although both used labor intensive production technology.

Expansion of new or underdeveloped sectors of the Moroccan farm economy, such as the livestock and the dairy industry, offers a realistic method of raising the total, average and marginal productivity of human labor in the agricultural sectors of the economy. The introduction of small amounts of scarce capital resources, together with improved utilization of unemployed or underemployed rural labor and land resources through changes in farm structure and organization, would be beneficial to the entire Moroccan economy.

Expansion of the livestock industry would result in greater total output of a wider variety of goods and services. At the same time, it would provide fuller employment for agricultural labor in or near its existing location.

It was recognized in this study of milk and meat production, processing and distribution in both Morocco and Turkey that milk cows and dairy cattle were not only kept for milk production purposes, but also for red meat production. In areas and countries with plentiful rural human labor and plentiful low quality roughage feed materials, increased cows per man needs to receive more attention than trying to increase milk per cow with high value feed concentrates that could be used for direct human consumption. The dairy cow is outstanding in her ability to refine feed materials unusable by humans into valuable food products such as milk and meat. The expansion of milk production through expansion of milk cow numbers will give more dairy beef as well as more milk output. It also will provide more human resource labor employment opportunities.

As the economy develops and the price of farm labor rises, the increased specialization of the cattle industry into a milk producing sector and a beef and veal producing sector normally will occur. Within the meat production oriented sector, the breeding cattle herds frequently can be advantageously separated from the cattle feeding and fattening operations. This more effectively utilizes the different types and amounts of feedstuffs available in different geographical production areas.

More research is needed to determine the extent of over-specialization of individual worker work assignments on the large labor force farms.

Worker development needs to be oriented more towards seeing the individual person's role within a larger whole farm firm business context.

The development of locally based educational and tourist services needs encouragement. Also, small scale production and servicing of goods from local natural resource materials and small quantities of purchased raw materials needs emphasis. That would provice local alternative human resource employment on a full-time and part-time basis and on a seasonal full-time and part-time basis. The combination of farm and non-farm labor and management resource employment within single individuals and individual family units as well as at the firm or village levels would be highly useful in broadening the individual worker's horizons and level and scope of skills and abilities.

Project No. A-18-BC

MARYLAND FARM AND OPEN COUNTRY REAL ESTATE TRANSFERS

Values of farm real estate increased at a relatively rapid rate over the last two decades without comparable increases in farm income. This project was originated to (1) Generate data on the quantity and sale prices of open country land transfers and (2) Determine the factors related to land prices.

The demand for land increases as the population grows and the economy expands. With a given quantity of land (measured as geographic space) available, increased demand results in higher prices, because more people are bidding against each other for a given parcel of land. Increased demand results from the demand for more land for housing, roads, parks, schools, recreational facilities, industrial uses and business sites.

The population of Maryland increased about 32 percent between 1950 and 1960 and another 26 percent between 1960 and 1970. During the last decade, population of Baltimore City, Allegany and Somerset counties declined with increases in the remainder of the counties, particularly within the Baltimore-Washington corridor counties.

The increased demand for land was for non-agricultural uses, but most of the demand had to be satisfied with land which had previously been in farms, forests and other rural open space uses. Specific physical requirements for non-agricultural and forest uses are frequently more stringent (that is, less land can be used for these purposes) than agricultural land.

Thus, prices for land which can be used for non-agricultural purposes are bid up higher than their agricultural values. Suitability of land for non-agricultural purposes -- which is mostly affected by location and zoning class -- changes over time depending on the growth of urban and suburban areas, location of new and improved transportation routes and development of water and sewage facilities. Therefore, another demand for land is created--land for speculative purposes.

Urbanization and land development within the rural-urban fringe or within rural areas affects farmers in two opposing ways. First, the development may result in land appreciation, because the farm-landowner's land becomes more valuable for non-agricultural purposes. Thus, if and when he decides to sell his land and change to a new occupation or to retire, his land can be sold for a much higher price than in the cases where there is an absence of development taking place. On the other hand, non-farm land uses within agricultural areas may result in less freedom to perform certain tasks, less freedom in selecting enterprises and practices, an increased property tax load and more costly land, if he desires to expand the acreage of the farm.

The amount of open country land transferred from one owner to another during 1965 varied from 5.95 percent of the total land area in Frederick County to 1.78 percent in Dorchester County. The average for the 23 counties was 4.5 percent. Generally, location with respect to urbanizing areas or with respect to water-based and population growth were associated with rates of ownership transfers and prices of real estate.

The average price per acre of land sold in 1965 varied from $3,124 in Prince George's County to $98 in Garrett County. These prices included buildings as well as "raw" land. Average prices in counties with a larger proportion of land sales with buildings are higher than counties with a large proportion of land sales without buildings.

Generally, prices were higher in counties with a larger volume (proportion of total land area) of land sales than in counties with a smaller volume. Price per acre of real estate was associated with location with respect to urbanization areas and water-based recreation areas and rates of population growth.

Volume--acres of land transferred -- for the state as a whole, excluding less than one-acre lots and lots within city boundaries, was 3.64 percent of the total land area in 1965 and 3.76 percent in

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1964. The average price per acre was $982 in 1965 and $970 in 1964. Average price per acre in 1965 was less than that of 1964 in eight counties and higher in 15 counties. Per acre decline was $68 in Anne Arundel County and $738 per acre in Prince George's County. Variations among sales prices over time within counties are largely explained by the type of land, volume and size per tract sold. As these factors change, prices vary.

Project No. A-18-BB

STRUCTURE OF MARYLAND GRAIN PRICES

The latter stages of this project involved the development of computer simulation models to determine the least cost method of allocating corn and other grains (wheat, barley, oats, and rye) needed for fulfilling livestock and poultry feeding requirements in Maryland. In models where Maryland grain production resulted in a deficit or surplus, the models either brought in needed grain or allocated the surplus to out of state areas.

Models developed were as follows: (1) Basic, (2) High grain requirement, (3) Low grain requirement, (4) High grain production, (5) Low grain production, and (6) Ten percent transportation cost increase. The basic model took average data for crop production, number of animal units, etc. for the study period October 1, 1963 to September 30, 1967. The other models (except 6) were adjusted to show highest or lowest grain production or number of animal units found for any one year out of the study period 1963-1967. The transportation cost increase model just increased transportation costs by 10 percent with all other factors remaining constant.

The six models discussed above were analyzed under two situations. Situation I took grain storage location and capacity as actually found during the 1963-1967 study period. Situation II allowed the computer to optimally locate storage regardless of how it was actually located in the field in 1963-1967.

Table 1 shows the minimum cost for each of the above situations. For corn in Situation I, minimum costs varied from $3.9 million for the low requirement model to $5.1 million for the low production model. For other grains in Situation I, minimum costs varied from $761,624 for the basic model to $815,308 for the high production model. In each model for corn or other grains, Situation II shows a smaller cost than Situation I. This is expected since the computer was able to locate storage where it would do the most to minimize costs yet meet storage requirements by area and volume.

Table 1:   Minimum Costs for Transporting and Storing Corn and Other Grains by Model Type and Storage Location

Model	Situation I[a]	Situation II[b]
CORN		
Basic	$4,066,300	$3,780,552
High Requirement	4,318,811	3,976,735
Low Requirement	3,907,405	3,486,414
High Production	4,281,599	3,707,770
Low Production	5,113,406	4,981,120
10% Transportation Cost Increase	4,245,198	3,963,478
OTHER GRAIN[c]		
Basic	$ 761,624	$ 709,742
High Requirement	765,107	708,217
Low Requirement	764,260	716,314
High Production	815,308	755,421
Low Production	726,414	677,103
10% Transportation Cost Increase	776,619	737,326

[a]Storage location as found in 1963 − 1967.
[b]Storage optimally located by computer
[c]Wheat, oats, barley and rye

Many of the cost changes cited above can be explained by the physical changes in production or requirement and by deficit or surplus grain production in Maryland

A publication, *Seasonal Price Fluctuations for Maryland Grain,* has been released, It is MP 724, *Maryland Agricultural Experiment Station* by R. F. McDonald and J. L. Runyan, 1969.

IMPACTS OF REGULATIONS AFFECTING COMPETITION, INDUSTRY ORGANIZATION AND PRICES OF FLUID MILK

This study was a comparative analysis of local, state and federal milk health regulations. Local health regulations were found to have had greater economic impact than state and federal regulations. In many cases, local regulations had made fluid milk markets less competitive by eliminating or restricting out-of-market sources of supply. These laws and policies have, directly or indirectly, affected the competitive position of different groups in the fluid milk markets. Local health ordinances have often provided economic protection to local producers and handlers and increased the bargaining power of local producers' organizations.

Compliance with public health regulations has increased the capital requirements and operating costs of dairy farms. However, it was such requirements as duplicate inspections and discriminate fees that exerted the major burden on costs and achieved the most local market protection. These regulations also helped to develop techniques of production and distribution. Limiting the geographic area of production or processing, for instance, prevents dairy firms from building plants of optimum size and operating them at optimum capacity.

Markets with restrictive sanitary regulations were found to have higher prices for fluid milk.

Public health regulations have stimulated milk consumption by improving the sanitary quality of milk, but they have discouraged the introduction of new fluid milk products and innovations in fluid milk distribution.

Regression analysis was used to estimate the relationship between regional differences in fluid milk prices and the distance to Northeastern markets from a surplus market in the Midwest. Regression equations for the years 1950, 1960, and 1971 were found to be as follows:

$$(P_J - P_0)_{1950} = .7737 + .0011D_J \qquad R^2 = .3720$$
$$(2.6805)^* \qquad (3.6101)$$

$$(P_J - P_0)_{1960} = .1985 + .0016D_J \qquad R^2 = .4558$$
$$(.6755) \qquad (.0014D_J)$$

$$(P_J - P_0) = -.0513 + .0014D_J \qquad R^2 = .6495$$
$$(-.3342) \qquad (7.9374)$$

Where:

P_O = Dealer's buying price at Milwaukee, Wisconsin

P_J = Dealer's buying price at Northeastern Market J. and

D_J = The distance between market J and Milwaukee, Wisconsin

*The figures between brackets are "t" statistic.

Thus, between 1950 and 1971 price differences between Midwestern and Northeastern markets became more closely associated. Similar conclusions were reached by comparing actual prices in Northeastern markets with calculated prices based on surplus prices in Wisconsin plus transportation costs to each Northeastern market. The mean of the deviation between actual and calculated prices were found to be $.20, $.05, and $.00 for 1950, 1960, and 1971, respectively.

In 1972, fluid milk markets in the Northeast were found to be more competitive in terms of the free movement of milk. This was a result of the gradual decline in the importance of local public health regulations as more and more fluid milk sanitary regulations were transferred from local to state and federal public health agencies.

The dairy industry has been more thoroughly regulated and more extensively investigated by the courts than any other agricultural industry. Early regulations were concerned primarily with the adulteration of milk. Later sanitary regulations included many provisions regulating different stages of production, processing and distribution. The legal basis for the sanitary control of milk is derived from the police power granted to the state by the Federal Constitution to protect public health. The state may, in turn, delegate this power to its subdivisions. The federal government may exercise sanitary control only over milk shipped interstate commerce, and milk used in federal territories and military establishments.

The court cases examined included disputes over the right to promulgate and enforce health regulations which involved permits and inspection, bacteriological and chemical standards, pasteurization and cooling of milk as well as grading, containers, labeling and dating of milk. The courts have generally upheld public health regulations as long as they were related to public health, consistent with higher statutes, reasonable and not capricious, arbitrary or discriminatory. The courts have also ruled that health regulations should be enforced in a reasonable and non-discriminatory manner.

Conflicting court decisions over some provisions of public health regulations were occasionally found. Court decisions have often been reversed on appeal because of changing conditions of production, processing and distribution of milk over time. Rapid technological changes inside as well as outside the dairy industry have created new situations that caused the courts to invalidate outdated regulations. For example, early regulations had excluded distant milk for valid public health reasons. With technological advances in transportation, refrigeration and pasteurization, such regulations had little public health significance.

Since the end of World War II, court cases have been frequently concerned with the economic aspects of milk sanitation. The courts have generally rejected the use of public health regulations for any purpose not closely related to public health. As a result of court actions, public health regulations are no longer a major economic barrier to trade and competition. During the past 10 years, fewer court cases were found to be dealing with public health regulations.

Project No. A-26-CB

THE EXPORT MARKET FOR MARYLAND AGRICULTURAL PRODUCTS

The United States is the world's largest agricultural exporter. Agricultural exports constitute a major share of the United States' agricultural production. U. S. agricultural exports have expanded rapidly in recent years. In fiscal 1972, the U. S. exported 21 percent of her total acres harvested. This included one-half of the soybean production, 42 percent of the wheat, 30 percent of the tobacco and 22 percent of the corn production.

During the report period the project leader conducted several research projects under the general project heading. These projects provided new information on the export market for Maryland type agricultural products. The specific subprojects are listed and described below:

1) *"Analysis of the Effects of Economic Development in Spain on the Demand for United States Agricultural Products".*
This study was financed in part by the United States Department of Agriculture. It analyzed and projected Spain's import demand for U. S. agricultural products. Spain's agricultural imports increased rapidly in the 1960's because of rapidly rising incomes and consequent increased demand for animal products there. U. S. feed grains and oil meals have been providing an increasing portion of Spain's animal feeds. Spain has been trying to supply more of her own feed grains need by switching acreage from wheat to barley. The Spanish market for U. S. agricultural products is expected to continue to grow with continued growth in Spain's population and national income, although increasing competition is expected from Europe and South America.

2) *"Least Cost World Trade Patterns for Grains and Meats".*
This study detailed the various costs involved in shipping agricultural products in international trade. It compared actual international shipping patterns and costs for the major agricultural products with the least cost pattern as determined by linear programming. It was found that the deviations from the least cost trading patterns increased shipping costs more than 20 percent for wheat and rye: 10-20 percent for barley, corn, soybeans, beef and veal, and pork; but less than 10 percent for oats, poultry and lamb. A reduction of 10 percent in outgoing U. S. freight rates had virtually no effect on the least cost trade pattern. The deviations in trade from the least cost patterns increased shipping costs by about one percent of the value of the goods shipped.

3) *"The Indian Foodgrain Market".*
Two studies were completed dealing with factors affecting U. S. agricultural exports to India. They focused on India's agricultural export planning process and India's foodgrain marketing system. India has been the U. S.'s largest market for wheat and is a major importer of U. S. soybean oil.

4) *"The United Kingdom Market for U. S. Soybeans and Soybean Products".*
This study was conducted in 1972 in cooperation with the American Soybean Association. It focused on factors affecting U. K. imports of soybean oil and soybean meal.
U. S. soybean meal exports to the U. K. are affected mainly by soybean meal prices, world supplies of fish meal, U. K. livestock numbers and tariffs. Soybean meal exports to the U. K. are expected to double in five years if U. S. supplies remain adequate and prices competitive. U. K. demand for soybean oil is increasing. This is due in part to increasing U. K. demand for soft margarine and reduced tariffs. Competitive pressure from palm oil is increasing and will be a serious threat to U. S. soybean oil exports to the U. K. in a few years.

Project No. A-26-BM

OPTIMUM LOCATION OF LIVESTOCK AND MEAT
MARKETING FACILITIES IN THE SOUTH

All work was completed on this project and results were published in a bulletin, "Marketing Livestock in Maryland," Misc. Pub. 743, Agricultural Experiment Station, University of Maryland, College Park, Maryland, March 1970.

Maryland is deficit in production of livestock relative to its growing human population. During the period of this study, 1962-1967, there was a further widening of the gap between the human population growth and the number of livestock available for marketing and consumption. The objectives of this study arc to: (1) Develop a simulation model of the market for Maryland livestock; and, (2) Determine the level of use of Maryland livestock market facilities under seven alternative marketing cost relationships.

Estimates based on the existing statistical trend show that livestock receipts at Maryland markets will be less by the latter part of 1969. Ten of the 14 auction markets are expected to continue their downward trend while only four are expected to show a slight increase.

Minimum cost flows of the production of livestock in Maryland from producing counties through marketing outlets to demand regions were simulated through the use of a linear-programming transportation model. Final demand regions and their source(s) of supply were delineated by dividing the state into five regions and defining any out-shipment as to a sixth region.

Table Estimated marketing bill, percent of capacity utilized currently and simulated by alternative models, 15 markets, Maryland.

Model	Estimated marketing bill	(In percent) Livestock Market														
		1	2	3	4	5	6	7	8 9	10	11	12	13	14	15
I	$31,314,17	80.5	4.9	27.9	100.0	61.9	0	100.0	43.9 0	0	26.5	100.0	95.5	100.0	1.4
II	$30,500.87	80.5	7.6	21.9	100.0	62.5	0	0	43.9 0	0	26.5	100.0	95.5	100.0	1.4
III	$29,782.50	80.5	8.6	21.9	30.6	62.5	0	0	71.7 0	0	26.5	100.0	95.5	84.5	1.4
IV	$27,457.72	80.5	10.5	21.9	30.6	57.5	0	0	71.7 0	0	26.5	100.0	72.5	84.5	1.4
V	$31,353.11	80.5	7.6	21.9	100.0	62.5	0	0	43.9 0	0	26.5	100.0	95.5	100.0	1.4
VI	$31,494.64	80.5	8.6	21.9	63.3	62.5	0	0	58.6 0	0	26.5	100.0	95.5	84.5	1.4
VII	$31,742.04	80.5	8.6	21.9	30.6	62.5	0	0	71.7 0	0	26.5	100.0	95.5	84.5	1.4
VIII	$31,638.25	80.5	9.8	43.3	100.0	58.7	0	100.0	43.9 0	0	26.5	100.0	95.5	100.0	1.4

Following the primal run, seven alternative models were simulated in which costs were varied by 5, 10 and 25 percent. In models II, III and IV, markets operating at less than capacity in the primal model had their costs reduced while in models V, VI and VII, markets operating at capacity in the primal model had their costs increased. In model VIII, the terminal market was excluded and only auction markets considered. The optimum solutions minimize the total livestock market bill for the state.

Project No. A-26-BP

EFFICIENCY AND COSTS IN BROILER PROCESSING PLANTS

Research was completed on this project and findings published in a bulletin, "The Delmarva Poultry Industry in Interregional Competition," Misc. Pub. 750, Agricultural Experiment Station, University of Maryland, College Park, Maryland, March 1970.

One of the major objectives in the study was to indicate the major markets in which Delmarva had a comparative advantage or disadvantage relative to other major broiler areas when cost associated with selected production and marketing factors were aggregated with transportation costs.

Based on aggregate cost differences, Alabama, Arkansas, Georgia, Mississippi and North Carolina had a cost advantage over Delmarva for ready-to-cook broiler meat shipped to all nine major city markets in both 1961 and 1967. Virginia had a cost advantage in all markets during 1961, but lost this advantage in the Boston, New York and Philadelphia markets by 1967.

Table 1. Aggregate cost differences per pound of ready-to-cook broiler meat for all production, marketing, and distribution factors from area supply origins to selected market outlets, 1961 and 1967

Origin	Year	Destinations								
		Boston	Chicago	Cleveland	Detroit	Los Angeles	New York	Philadelphia	Pittsburgh	St. Louis
		cent per pound								
Salisbury Maryland[a]	1961	23.3261	23.7661	23.3461	23.5461	25.7061	23.0561	22.9261	23.2061	23.8961
	1967	26.2802	26.8502	26.3102	26.5702	29.3002	25.9102	25.7502	26.1102	27.0202
Gadsden, Alabama	1961	-0.7206	-0.3406	-1.3506	-1.5206	-2.1606	-0.7806	-0.7606	-1.1006	-2.1206
	1967	-1.4389	-0.9689	-1.5089	-2.4789	-3.2689	-1.4689	-1.4489	-1.9189	-3.2589
Springdale, Arkansas	1961	-0.4580	-2.0480	-1.4180	-1.5280	-2.9380	-0.4180	-0.3780	-1.2180	-2.5580
	1967	-1.5746	-3.6546	-2.8046	-2.9846	-4.7346	-1.4846	-1.4546	-2.5246	-4.3146
Gainesville, Georgia	1961	-1.1023	-1.8723	-2.5123	-1.6723	-2.2423	-1.0823	-1.0723	-1.4223	-2.1723
	1967	-2.2215	-3.2215	-2.7615	-2.9515	-3.6515	-2.1715	-2.1615	-2.6215	-3.6115
Waterville, Maine	1961	-0.5420	-0.1120	-0.0520	-0.0520	-0.1320	+0.0080	+0.2480	+0.0480	+0.0180
	1967	-1.3428	-0.7128	-0.6128	-0.6128	-0.7028	-0.6028	-0.2928	-0.4628	-0.5228
Meridian, Mississippi	1961	-1.3571	-2.3571	-1.8971	-2.0771	-3.0971	-1.3271	-1.3071	-1.6571	-2.7671
	1967	-1.7611	-3.0711	-2.4911	-2.7211	-3.9811	-1.7011	-1.6711	-2.1611	-3.6111
Mocksville, North Carolina	1961	-1.9896	-2.3596	-2.2496	-2.2396	-2.5596	-1.9796	-1.9697	-2.1996	-2.5596
	1967	-2.6233	-3.0933	-2.9633	-2.9533	-3.3433	-2.6033	-2.5933	-2.8833	-3.3633
Nacogdoches, Texas	1961	+1.5730	+0.2830	+1.0430	+0.8530	-0.9870	+1.6230	+1.6930	+1.2430	-0.1870
	1967	+0.3511	-1.3689	-0.3889	-0.6389	-2.9489	+0.4511	+0.4911	-0.0889	-1.9789
Harrisonburg, Virginia	1961	-0.4271	-0.6271	-0.6071	-0.6071	-0.7371	-0.4371	-0.4171	-0.6271	-0.7671
	1967	+0.0678	-0.1822	-0.1722	-0.1622	-0.3122	+0.0778	+0.0778	-0.1822	-0.3722

[a] Delmarva aggregate cost used as base. Negative figures denote advantage; positive, disadvantage.

In the principal Delmarva markets of Boston, New York, Philadelphia and Pittsburgh, the areas having a cost advantage over Delmarva in both 1961 and 1967 ranged from a low of about 0.38 cents per pound for Arkansas into the Philadelphia market for 1961 to 2.88 cents per pound for North Carolina into the Pittsburgh market for 1967. Maine was at a cost disadvantage relative to Delmarva in the New York, Philadelphia, Pittsburgh and St. Louis markets in 1961; it had a cost advantage over Delmarva in all the markets by 1967. The only markets in which Texas had an absolute cost advantage over Delmarva in 1961 were the Los Angeles and St. Louis markets. By 1967, Texas had a cost advantage in all markets except Boston, New York and Philadelphia.

Alabama, Arkansas, Georgia, Mississippi and North Carolina -- the areas having the greatest absolute cost advantage over Delmarva in 1961 -- increased their cost advantage substantially by 1967 in the Boston, New York, Philadelphia and Pittsburgh markets, the major outlets for Delmarva broilers. The increase in cost advantage over Delmarva ranged from 0.36 cents per pound for Mississippi into the Philadelphia market, to 1.31 cents per pound for Arkansas into the Pittsburgh market.

Project No. A-26-BO

ECONOMIC ANALYSIS OF THE MARKET STRUCTURE OF THE COMMERCIAL FISHING INDUSTRY IN THE NORTHEAST

During the fiscal year work on the study was completed and the project was terminated. The following analyses were performed:

1. Time series data on consumption and price of various fishery products were collected. Consumer demand functions for several fishery products were then estimated using single stage least squares.

   The demand for most fishery products was determined to be price inelastic. Income elasticities were usually less than one and negative for some products. The price and income elasticities for oysters were determined to be -0.17 and -1.21, respectively.

2. Cost data was collected to determine possible economies of size in crabmeat picking, oyster shucking and clam shucking operations. Piecework wages for shuckers and crabmeat pickers comprise over half the total cost in all cases when payroll taxes are included. Because of this, economies of size were relatively small.

3. A general bio-economic model was developed to explain the economic and biological relationships inherent in the major shellfish harvesting industries of the Chesapeake Bay. Simulation techniques were employed to evaluate the estimated systems and to project landings, prices, employment and net incomes into the future. In Maryland, 1975's projected landings are virtually the same as the 1968 catch; crab landings are expected to be somewhat less than the record 1965 catch. In Virgina, oyster landings are projected to be higher than in recent years, while crab landings are expected to follow the same pattern as the Maryland fishery.

The oyster model was also used to analyze taxation and state seeding programs in Maryland. The simulation runs indicate that increases in the oyster tax would have little impact on landings and would generate large increases in revenue to the state. The burden of a tax increase would fall almost entirely on the oystermen. On the other hand, the oyster seeding program leads to an increase in landings, employment and net income per oystermen.

Output of selected seafood products was projected by means of regression equations in which output of the processed product was regressed on the corresponding catch figures. Shucked oyster output in Maryland 1975 is expected to be comparable to levels recorded in the 1950's; crabmeat is not expected to change much. In Virginia, shucked oysters and menhaden products are expected to show modest increases, but crabmeat output will probably decline slightly. The projections

reported here assume preservation of the natural productivity of the fishery resources. If pollution of the Chesapeake Bay and its tributaries is not controlled, landings and output of related processed products may decline sharply.

Prjoect No. A-26-BV

THE EFFECTS OF U. S. AGRICULTURAL POLICIES AND PROGRAMS ON MARYLAND AGRICULTURE

This study, which terminated June 30, 1970, demonstrated a somewhat unique effect of U. S. agricultural policy and programs on the major facets of Maryland agriculture. Maryland farmers frequently responded collectively according to their own particular set of value judgments and agricultural conditions. This was contrary to producers of the same agricultural commodities elsewhere in the nation.

There was no tobacco price support and/or acreage diversion program for type 32 tobacco until the end of World War II. Neither did the producers of feed grains, wheat or milk show any particular interest in federal government programs.

Traditional attitudes of independence from government intervention was widely prevalent. Maryland farmers generally enjoyed slightly higher agricultural prices during the depression of the 1930's than farmers producing the same commodities in the major producing areas of the nation.

After receiving price support at approximately 85 percent of parity on type 32 tobacco for the 1948, 1949 and 1950 crops without the need for acreage allotments, the Maryland producer vote was negative for 1951 and 1952 before acreage allotments were accepted on the 1953 crop.

Subsequently, Maryland growers voted against accepting acreage allotments in order to get price support on type 32 tobacco for 1954, 1955, 1959 and from 1966 to 1973 inclusive. During this interval competition for other uses of land and labor has reduced the acreage and total supply of Maryland tobacco to less than pre-World War II levels despite record high prices. These developments indicate that a return to acreage allotments and price supports on type 32 tobacco is very unlikely in the immediate future.

Legally enforced minimum class I and class II prices to fluid milk producers in Maryland under federal orders have been enforced against handlers continuously since the early 1960's and now afford minimum price protection to practically all Maryland dairy farmers. This two-price system which involves no expense, except administrative, to the Treasury of the United States, now affords minimum price protection to all Maryland dairy farmers under the Middle Atlantic Federal Order, Number 4. The Middle Atlantic marketing area now includes all of the state of Maryland and the metropolitan centers of Washington, D. C. and Philadelphia. The minimum price protection afforded to Maryland dairy farmers by this program is highly significant because its development was associated with a complete shift of milk sanitary regulation from.local health departments to state health departments. This terminated the measure of economic protection afforded local milk producers by local health regulations and producer permits.

Project No. A-19-AE

COMPARATIVE IMPACT OF CURRENT AND ALTERNATIVE SYSTEMS OF TAXATION ON FARMS AND COUNTIES

Maryland, like many other states, has experienced rapid increases in governmental costs in recent years, at both state and local levels. These increases reflect the result of many factors, such as: (1) Inflation in general; (2) A rapid rise in numbers of functional units, such as pupils enrolled in public schools, or number of motor vehicles registered; (3) Improvements in, or expansion of, existing functions; (4) Adoption of new programs; (5) Adjusting salaries of employees to levels equal to those of federal employees or workers in the private sector; and (6) Rising interest costs on public indebtedness to provide facilities especially where population growth is rapid.

Under the above situations, it has become increasingly difficult to hold public expenditures within the productive capacity of a given tax system. Several times during the last ten years Maryland has utilized non-recurring state revenue producing measures to balance current budget needs. However, these windfalls do not solve the problem of continuing the functional programs or commitments. Eventually, another tax, or increases from the existing tax sources will become necessary.

Potential tax yields are an important aspect of planning state and local governmental programs. Therefore, it is desirable that state tax estimates for each ensuing budget year be as accurate as possible and completed at least six months in advance of the next fiscal year. These predictions of yield should also be helpful to counties, because state aids and the yields from some state levies comprise a substantial portion of county budgets.

Prospective tax yields from the various levies indicate the extent to which the tax system falls short of meeting program commitments. They may also disclose weaknesses in the tax structure and necessary tax changes to balance ensuing budgets. This part of budget preparation is important at both state and local levels. Prior to budget request preparations, department or agency heads could be informed of potential tax yields for the ensuing year, compared with the current fiscal year, before proposed budgets are requested.

When increases in state and local budgets are proposed, they cause speculation about a tax rise

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for one or more major levies, namely property, income or sales taxes. Actually, a considerable portion of most budgets (as much as one-third) represents amounts which are not of state or local tax origin. Earnings of governmental agencies, service charges, grants from the federal government, state aid to local units, capital outlays and the sale of bonds comprise a considerable share of state and local budgets.

About 80 percent of the taxes from the state general fund comes from the two major levies, the income tax (on individuals and corporations) and the general sales tax. Therefore, the future tax potential for state general purposes lies within these two resource areas. If all of the minor tax levies were doubled, they might not produce sufficient revenues for increasing costs of government, especially when such costs are rising because of inflationary factors.

The major general fund tax sources (the personal income tax and the general sales tax) still have considerable additional revenue potential. Broader application of the sales tax to untaxed services, and even the taxation of food purchased for home consumption, could add possibly 20 to 30 percent more revenue to the present four percent sales tax.

A more realistic graduation of the personal income tax should produce considerably more revenue. It could also make the tax impact more equitable among the three predominant groups of taxpayers; single persons, married couples filing separate returns and married couples filing joint returns.

Data concerning the option of married couples to file separate returns were obtained from several other states. These data showed a substantial increase in the percent of married couples who can or do file separate returns. From the data, it was not possible to accurately compute tax reduction (or revenue loss to the state) resulting from married couples filing separate returns. However, one may expect that as tax rates are increased or taxable incomes are raised, the choosing of the separate return option by married couples would become more prevalent because the tax saving would be greater.

The major sources for special or dedicated state purposes include the highway user levies and the state property tax. With the exception of the motor vehicle titling tax, recent yield trends of the highway user levies have followed a normal pattern related to increases in numbers of motor vehicles and highway traffic. Property tax increases reflect the upward trend in real estate values and new property improvements. This has occurred with a rather stable state tax rate per $100 of assessed value.

For county purposes, the property tax remains the major tax source. The authority to levy a local income (piggy back) tax not more than one-half the state income tax offers considerable property tax relief in those counties where a relatively large proportion of the taxpayers have high incomes or where dual spouse full-time employment (even at medium earning levels) is comparatively high. However, in counties where these factors are not prevalent to any great extent, the relief from property taxation will be rather modest. Furthermore, recent legislation which authorizes county governing bodies to exempt personal property from county taxation will soon leave real estate as the only local property tax resource.

Real estate taxes have several unusual characteristics. They possess a reasonable certainty of yield except in extreme recession periods. In addition, much of the real estate is owned by people who have a reserve of economic capacity. However, real estate taxation is highly regressive in several ways, and especially so in this era of increasing dual spouse employment and emphasis upon material goods and services.

Furthermore, the real estate tax is like a double-edged sword. On the one hand, it is pledged to secure public debt, and it may be sold for unpaid taxes. These forced collection features do not apply to the other two major levies, namely income and sales taxes. If one has no taxable income,

no income tax is payable and one pays a sales tax by choice rather than by force.

Average yearly increases in real estate taxable values between 1968 and 1969 ranged from 4 percent to nearly 16 percent among 10 selected counties in Maryland (Table 1). This reflects higher assessed values in some counties and a combination of new buildings and higher values in other counties, together with a higher average county tax rate.

Table 1.   Property Tax Base, 10 Selected counties of Maryland, 1969 and 1968.

County	Full rate total taxable basis			Real estate taxable basis only		
	1968	1969	Increase 1969 over 1968	1968	1969	Increase 1969 over 1968
	- - ($Mil.) - -		(Percent)	- - ($Mil.) - -		(Percent)
Allegany	276.7	286.0	3.4	186.5	195.4	4.8
Anne Arundel	929.3	1016.1	9.3	759.5	839.9	10.6
Cecil	158.3	166.2	5.0	121.1	130.1	7.4
Dorchester	95.5	99.4	4.1	65.7	68.0	3.5
Frederick	356.6	383.1	7.4	248.9	275.0	10.5
Garrett	80.5	82.5	2.5	40.0	44.0	10.0
Montgomery	2838.1	3116.5	9.8	2414.5	2682.3	11.1
St. Marys	98.3	109.1	11.0	82.5	92.2	10.5
Talbot	114.3	125.2	9.5	90.4	99.5	10.1
Worcester	149.6	167.3	11.9	113.5	131.1	15.5

Meanwhile, county exemptions of personal property from taxation have, during recent years, offset to some extent the growth in real estate taxable property resources in many counties. Moreover, further deletion of personal property at the county level is expected to result in the complete exemption of such from local resources. This condition will gradually curtail the property tax resources for current operation of the counties. It will also eventually limit the property base primarily to real estate for servicing bonds which were issued when both real and personal property were on the tax rolls and presumably pledged toward the servicing of public debt.

It appears, therefore, that budget requests for increases of 10 to 25 percent could not be supplied from the growth in property values in many counties. The solution to the problem lies in four areas: (1) Curtail the budget requests; (2) Prevail upon the state to increase its functional aid and shares; (3) Authorize counties to levy another tax which will produce substantial revenues; and (4) Increase the county property tax rate.

Project No. A-19-AC

DAIRY ADJUSTMENTS AND SUPPLY RESPONSES
IN MARYLAND AND THE NORTHEAST

The trend toward larger but fewer dairy farms has drastically changed the organizational structure of the national, Northeastern and Maryland milk production industry. The shift toward larger individual farm businesses has created the need for much greater financial investment, and in many cases more credit, per individual farm business. The past economies in the use of labor on moderately large dairy farm businesses have been substantial, and a large amount of farm labor has been released from the milk production industry. More labor will be released in the future as human farm resources are reorganized with other non-human productive resources to increase labor productivity per worker.

The larger dairy farms also offer a means of economizing on the use of capital through the multiple use of milking facilities with several shifts of workers daily. The higher levels of managerial capacity needed to operate larger dairy farm businesses have been spread over more units of output so that the management costs per unit of output have declined on the larger dairy farms.

It is most probable that the trend toward more efficiency in the use of land, labor, capital and management resources on dairy farms will continue in the 1970's. The major push toward larger dairy farms in the future years will come from the need for individual operators: (1) To earn higher levels of income from the fuller use of their labor and management resources, (2) To take advantage of the new developments in large-scale handling of dairy cattle with high capacity buildings and equipment, and (3) To capture off-farm efficiencies in raw materials procurement and sales of farm product production. The advantages of large farm size in generating purchasing and distribution efficiencies for raw materials together with marketing and procurement efficiencies for milk assembly at initial concentration points will continue to exert pressure toward a smaller number of larger dairy farm businesses.

The rewards for higher levels of managerial ability on dairy farms are substantial. However, many farm managers and farm owner-operators either do not want to manage larger businesses, or they do not possess the ability to acquire and to effectively manage the larger amounts and qualities of land, labor, and capital resources needed on relatively large dairy farms. This means that a wide range of sizes in dairy farms will continue to exist in the future. However, those farms with fewer than 150 cows or 2,100,000 pounds of milk sold will be subject to severe competitive pressures which in turn will mean that their land, labor capital and management resources will earn relatively lower net returns compared to the resources used on the larger farms. The resources used on the relatively small farms generally will not be able to command the going average market rates for these resources because of lower than average rates of resource productivity especially with respect to their management ability, labor resources and financial capital resources.

This research analysis indicates a number of points that dairy farm managers need to consider in their future plans for long-run dairy adjustments.

The positive effects of increased milk sales per cow on all measures of farm profits makes this an area of primary concern for improving dairy farm business, increasing productivity per worker, and strengthening the future competitive position of dairy farmers relative to other types of farmers. The annual productivity per worker is doubled from 350,000 to 700,000 pounds of milk sold per man when milk sales per cow increase from 7,000 to 14,000 pounds of milk sold per cow and cows handled per worker remain fixed at 50 cows per man. Of course, an increase from 10 to 50 cows per man will increase output from 70,000 to 350,000 pounds of milk per man at the 7,000 pound level. A similar increase in cows per man at the 14,000 pounds per cow level will result in an increase from 140,000 to 700,000 pounds of milk sold per man. Some dairymen with small herds may strive to get a high productivity per worker such as 700,000 pounds of milk sold per man with fewer cows but higher milk sales per cow, e.g., 35 cows at 20,000 pounds of milk per cow. This trade-off of more productivity per cow and fewer cows per man will yield the same labor productivity as the 50 cows and 14,000 pounds of milk sold used in this analysis.

The physical and financial advantages of large dairy farms are most significant in moving to herd sizes of approximately 150 cows. These economies occur because of the relatively full utilization of buildings and equipment as well as full utilization of labor capacities and the milk producing capacity of the cows. Sizes of herds beyond this size level also give economies in the cost of building and equipment primarily through the use of larger buildings and machinery. Once the larger machinery units and buildings have to be duplicated in order to continue the expansion of cow numbers and milk output, the advantages of increased size with respect to overhead cost reduction per unit output are relatively few. Improved profits and higher efficiency of resource use result from the *full utilization of available resource capacities*.

The major advantage of farms above 150 cows or 2,100,000 pounds of milk output in size is the larger volume of milk sold at relatively stable or slightly larger margins of net return. This means that the individual farm manager can increase his total income by continuing to add efficiently organized herd units of cows and their resource requirements to the farm firm.

Advantages with respect to the cost of acquisition of farm resources currently appear to be substantial up to approximately 150 to 200 cows. There would appear to be some advantages in off-farm feed purchases and bulk feed delivery as well as in milk hauling from the farm with the larger sizes of herds.

The potential impact of purchasing and marketing efficiencies on the large dairy farms, together with the possibilities of raising net income per farm operator, indicate the possibility and high probability that the trend toward larger dairy farms will continue to occur in the future throughout the United States, the Northeast and in Maryland.

The complete dry-lot dairy operations with all feed and replacements purchased off-the-farm were generally not profitable in most areas of Maryland under average cost conditions and moderate levels of milk output. Although at extremely high levels of milk sales per cow, they could be made to yield a positive net return. The dry-lot dairy farms under minimum cost assumptions were able to generate a positive net income, especially at the large sizes of herd and higher rates of milk sales per cow. However, these minimum cost assumptions would not be appropriate on many dairy farms.
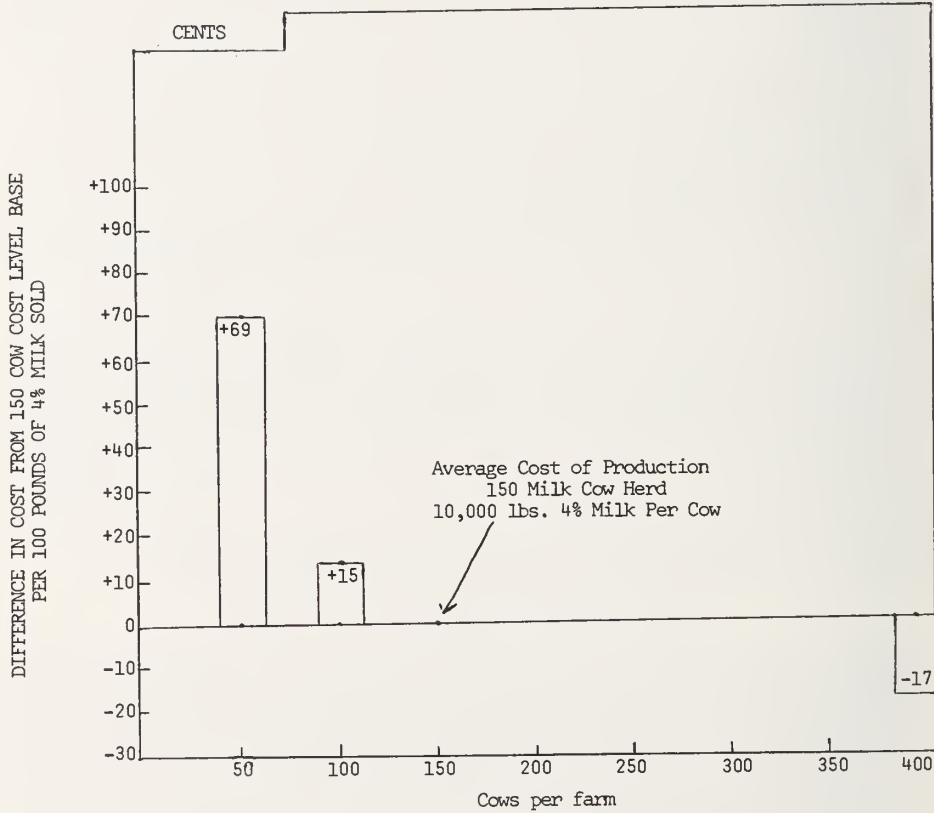

Figure 1. Rapid Initial Reduction in Costs Per 100 Pounds of Milk Sold as Size of Herd Expands to 150 Cows.

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The standard specialized dairy farms that produce all of their own roughage requirements and all of their dairy replacements have the advantage of lower cost feed and lower cost dairy replacements as well as the economies which generally accure to larger sizes of herds and higher rates of milk output per cow in terms of labor efficiency. The standard specialized dairy farms with above average crop yields had higher annual net returns than the standard dairy farms producing average crop yields. This type of operation would appear profitable from a strictly short-term production efficiency point of view because land and labor are used more efficiently. However, it must be remembered that *those types of operation which utilize smaller quantities of land resources do not offer as much potential for long-term capital gains or losses* through increases or decreases in the value of farm land and buildings during periods of rising or falling farm real estate prices.

This latter factor of long-term capital gains on farm real estate has been of considerable importance to many dairy farmers since 1935. However, it should be remembered that the period from 1920 to 1935 was characterized by generalized long-term capital losses on farm real estate. The long-term historical trend in average United States farm land prices also has been upward, but the impact on specific farms varies widely over time and geographical area.

No one knows for certain how much farm real estate prices will change upward or downward during the next decade or so. However, under existing and potential conditions of technology in this country, it does not appear that land for dairy farming will be in short supply during the 1970's. Depreciation of the purchasing power of the dollar will probably continue to a limited extent and this will help to keep prices stable or slightly rising. However, increased substitution of off-farm fertilizers, lime and chemicals for weed and pest control will tend to increase crop yields, lower or restrict prices of crops produced and restrict the net earning capacity of farm land resources used in pasture or other feed crops production.

Project No. A-18-AU

THE DEVELOPMENT OF A MANAGEMENT ACCOUNTING
SYSTEM FOR FLORICULTURAL FIRMS

The purposes of this project were: (1) To develop an accounting system designed for decision-making in floricultural firms and (2) To develop computer programs to implement this management system.

This project was the result of repeated meetings with industry leaders during which they expressed their research needs. During the first year of this project a series of in-depth interviews were conducted to determine the current accounting systems in use by floricultural firms. A second major goal of these interviews was to determine the types of information that floricultural firms need for efficient decision-making.

As a result · of these interviews, it was determined that there was a great need for short courses in business decision-making. These short courses were initiated as a part of the University's Extension Program.

A computerized record keeping system was developed for floricultural firms by modifying

ELFAC (Electronic Firm Accounting) which was an existing accounting system. The ELFAC system was developed by extension and research workers from colleges of agriculture in the Northeast. ELFAC is operated as a non-profit corporation and is sponsored by the individual Extension services in the Northeastern states.

A handbook was prepared illustrating the use of basic management concepts applicable to the needs of Maryland floricultural firms. The second half of the handbook described the use of ELFAC by floricultural firms. The use of improved management concepts and more accurate record keeping will help Maryland floricultural firms to meet the competition of out-of-state and foreign floricultural producers.

Project No. A-18-BE

ANALYSIS OF COSTS AND RETURNS TO THE BREEDER—OWNER SECTORS OF THE MARYLAND HORSE INDUSTRY

In the past two decades, the growth and development of the horse industry in Maryland has been spectacular. This growth is, and can continue to be, of increasing importance to agriculture. While neither food or fiber, the horse requires the use of increasing amounts of agricultural resources.

Given the basic objective of assisting in the development of the horse industry, one prerequisite for evaluating alternative programs or policies is an in-depth analysis of all sectors of the industry. One important sector—and the most closely related to agriculture—is the breeder-owner sector, those commercial breeders supplying yearlings and older horses to the industry. Where and in what way their economic returns might be increased are the basic economic questions. Delineation of the basic factors influencing costs and revenue is therefore warranted.

Specifically, the objectives of this study are to:
1. Determine breeder-owner costs and returns relative to recent changes which have occurred in the industry.

2. Evaluate possible economic alternatives.

Progress to Date:
A list of Maryland Standardbred and Thoroughbred breeders was developed and arbitrarily divided into the size categories shown in Table 1.

Table 1.   Maryland Breeders; their Number and Size of Operation, 1968—70

| | Number of Mares | | | |
| Breed | 1 or 2 | 3 to 5 | 6 to 10 | More than 10 |
	No. %	No. %	No. %	No. %
Standardbred	149 (75.6)	25 (12.7)	15 (7.6)	8 (4.1)
Thoroughbred	395 (76.7)	77 (15.0)	31 (6.0)	12 (2.3)

Source: Department of Agricultural and Resource Economics

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Data were obtained from a sample of these breeders on their investment, activity, other agricultural enterprises, employment, expenditures on feed, wages, equipment, veterinary care and other items. Data on income, by source and activity, have also been obtained.

Data from the questionnaires have been coded, keypunched and put on magnetic tape. Relevant data on all phases of the racing industry have also been put into a data base.

A data processing system has been designed which will allow incorporation of the breeder data with data assembled from other sectors of the horse industry in Maryland, and from similar projects currently underway in other states. Analysis will be limited, however, until data is collected from breeders in the non-racing segment of the industry.

To obtain this latter data, a sample of these breeders has been drawn from a detailed list containing the names of approximately 90 percent of the owner-breeders in the state with a detailed breakdown of their horses by breed, sex and age.

Initial Results:

The percent of total expenditures paid out for specific items by breeders in 1968 are presented in Table 2.

Table 2. Maryland Standardbred and Thoroughbred Breeder Expenditures; Percent Selected Items are of Total Expenditures, 1968

Item	Number of Standarbred Mares				Number of Thoroughbred Mares			
	1 or 2	3-5	6-10	More than 10	1 or 2	3-5	6-10	More than 10
Salaries & Wages	25.3%	28.9%	38.1%	49.6%	5.0%	26.8%	16.9%	27.5%
Payments in Kind	4.1	8.2	8.3	15.6	.6	5.7	6.6	3.0
Feed & Bedding	32.2	30.8	26.6	4.3	15.3	11.5	9.2	9.2
Vet and Drugs	4.0	3.9	6.4	3.0	3.5	3.3	2.5	2.7
Farriers	2.5	.8	1.5	.9	1.3	.9	1.2	.8
Vanning	1.9	3.0	2.0	1.4	1.4	1.0	1.7	2.2
Nominations	1.3	1.6	.9	1.6	.4	.2	.6	1.3
Registration Fees	.5	.1	.3	.1	.4	.1	.2	.1
Syndication Fees	0	0	0	.1	0	0	0	.5
Stud Fees	5.8	2.2	4.2	6.6	4.2	1.0	22.6	8.2
Board	10.0	4.2	4.4	2.3	5.7	1.5	5.8	2.3
Depreciation					18.7	21.8	17.9	17.8
Miscellaneous	12.4	16.3	7.3	14.5	43.5	26.2	14.8	24.4
	100%	100%	100%	100%	100%	100%	100%	100%

Source: Department of Agricultural and Resource Economics 1970 Survey of Maryland Breeders

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Thoroughbred farm; Baltimore County, Maryland.

While certain trends are evident from the data, for example, the relationship between the proportion of operating expenses required for wages and the size of farm, as previously stated, analysis is not complete. Conclusions which are not self-evident from the data depend on additional analysis which will be completed following collection of data from the non-racing segment of the industry. Given the large data base available, analysis of alternatives may warrant the development of a model of the functional relationships within the industry. Some consideration has also been given to developing a set of records to be completed by horsemen on a continuing basis. This would provide a means for monitoring significant changes in the industry.

Project No. A-18-BG

FOREST MARKET STRUCTURE

The final phase of this project dealt with the Maryland Christmas tree industry. Plantations of Christmas trees are relatively new in Maryland and little information is available on the state-wide production and marketing of these trees. A survey of growers helped fill this knowledge gap by clarifying the structure of the Maryland Christmas tree industry.

Maryland was found to have two distinct Christmas tree growing areas on the basis of climate, topography and soil. One area (the Piedmont region) was close to metropolitan areas, while the other (the Western region) was more distant. Even though the regions were physically distinct, the per tree costs of production in the two regions were not significantly different. State-wide, the average production cost per tree was $0.72, with a standard deviation of $0.24.

Growers in both the Piedmont and Western regions marketed trees by a variety of methods. Most trees were wholesaled at roadside in the Western region, while retailing trees by "choose and cut" was most popular in the Piedmont region. Although still in an experimental stage, selling balled and burlaped trees is being tried by increasing numbers of growers in both regions.

WESTERN MARYLAND COUNTIES

PIEDMONT MARYLAND COUNTIES

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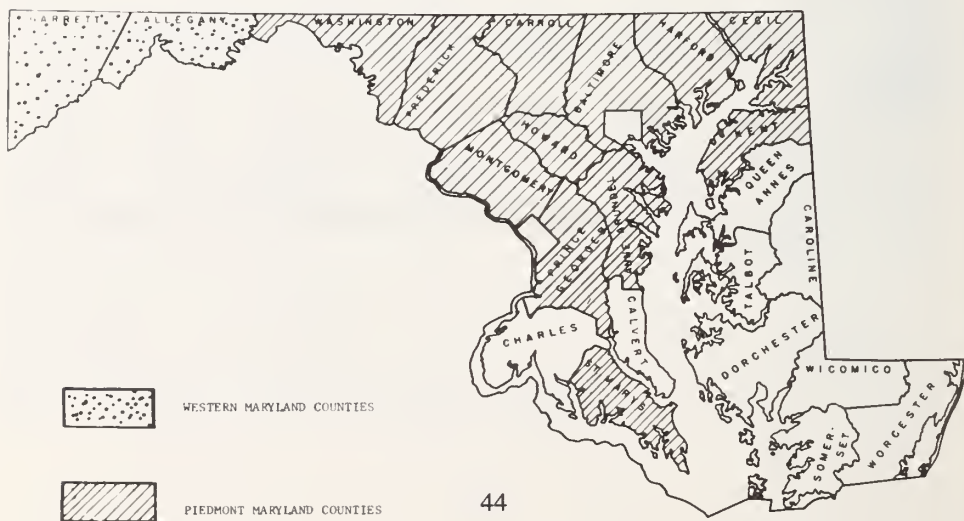
Wholesaling was found to be the least expensive way of marketing trees, retailing by "choose and cut" was next and selling live trees was the most expensive. In reverse order, balled and burlaped trees were most profitable, "choose and cut" operations were second and wholesaling cut trees was least lucrative. The average profit per acre for growers in the state was $134.00. In the Western region, a profit figure of $87.00 per acre was obtained. In the Piedmont region, average profits per acre were $173.00. Thus, the production costs between the regions were essentially the same, but location and the costs and methods of marketing significantly influenced profits.

Project No. A-26-BY

OPTIMIZING RESOURCE USE IN C & O CANAL
REGION AND EFFECT IN ADJACENT RURAL AREAS

Most of the data collected on the park user survey at Harpers Ferry National Park and at Fort Frederick State Park has been tabulated, and preliminary analysis has been done. A more detailed, quantitative analysis is being done to try to fit some of the data into a regression equation explaining the visitation at a given park site. Some of the variables which will be included in the model are per capita income, distance from the park and number of people in the group.

Preliminary review of the tabulated data have revealed no surprises, but have shown some interesting information. For example, half the visitors were on one day trips and one third were on their annual vacation. Nearly 75 percent were visiting the park for thr first time. Similarly, 60 percent had not ever visited the C & O Canal.

The results suggest that development of the Canal would attract a considerable number of people into an area that otherwise would seldom be visited.

Project No. A-19-AF

THE ECONOMIC IMPLICATIONS OF WATER QUALITY CONTROLS
AS THEY RELATE TO DAIRYMEN IN THE MONOCACY RIVER WATERSHED

This project was initiated on July 26, 1972. The objectives of the study are to: (1) Determine the amounts of animal waste produced on dairy farms in the Monocacy River Watershed, (2) Develop a production systems profile with reference to animal waste disposal, (3) Determine the economic efficiencies and pollution abatement ability of the various production systems used, and (4) Determine how changes in or enforcement of water quality standards would affect the economic efficiencies of the dairy production systems used and the quality of surface waters of the watershed.

The initial phase of this study defined the Monocacy River Watershed to include approximately 500 square miles of drainage area in Frederick County, 212 square miles in Carroll County and 30 square miles in Montgomery County, or a total of 742 square miles in Maryland. The Moncacy River Watershed extends into Pennsylvania which includes 228 square miles, most of which are located in Adams County.

All commercial dairy farms in the watershed have been identified, located and classified according to herd size. The classification showed 420 herds with less than 50 cows, 310 herds with 50 to 89 cows, 89 herds with 90 to 129 cows, 25 herds with 130 to 159 cows and 21 herds with 160 or more cows, or a total of 865 herds (Table 1).

The survey questionnaire was developed and pretested. The sample was drawn and included a personal interview with 46 farmers having less than 50 cows in the herd, 41 farmers with 50 to 89

cows, 40 farmers with 90 to 129 cows, 15 farmers with 130 to 159 cows and 21 farmers with 160 or more cows, or a total of 163 farmers in the Monocacy River Watershed (Table 1). The 163 interviews represented 19 percent of the herds and 29 percent of the cows in the entire watershed.

Table 1. Number of Dairy Herds, Number of Cows, and Average Size of Herd for the Population and Research Sample in the Monocacy River Watershed

Herd Size Classification	Number of Herds	Number of Cows	Average Size of Herd
	Number	Number	Number
	POPULATION		
Under 50 Cows	420	14,276	34
50 – 89 Cows	310	20,897	67
90 – 129 Cows	89	9,567	107
130 – 159 Cows	25	3,655	146
160 or More Cows	21	5,032	240
Total	865	53,427	62
	SAMPLE		
Under 50 Cows	46	1,544	34
50 – 89 Cows	41	2,687	66
90 – 129 Cows	40	4,211	105
130 – 159 Cows	15	2,094	140
160 or More Cows	21	5,024	239
Total	163	15,560	95

Information from the 163 personal interviews is being checked and coded for processing. The processing should be completed by late spring.

Water quality check points (30) and standards of water quality have been established for the entire watershed.

Project No. A-18-BI

ECONOMIC ANALYSIS OF PINE FOREST RESOURCES ON MARYLAND'S EASTERN SHORE

A "drain" study conducted by the Maryland State Department of Forests and Parks found an overcutting of pines on the Eastern Shore of Maryland. The overcutting, if continued, is massive enough to completely remove the Eastern Shore's pine stands within the next several years. This project was initiated to find out whether or not the overcutting would continue, and to analyze whether or not more intensive forest management could balance the cut with an accelerated growth rate.

A woodland owner survey was conducted in the area to determine which landowners will sell their trees, which will replant seedlings after harvest, and which will manage their existing stands. The major finding of the survey indicated overcutting is likely to continue, since almost all of the timber owners are willing to sell their mature trees at existing prices. The larger landowners, who accounted for most of the acreage, are interested in replanting and in management of existing stands, though most of these owners let their stands grow naturally.

Supplies of growing stock can be increased through better management of existing stands. Since this seemed to be a positive way to help alleviate the drain problem, and since woodland owners seemed interested in it, an economic analysis of the feasibility of better stand management was undertaken. The original plan called for a literature survey to discover growth functions for loblolly pine. These growth functions would then form the base for the economic analysis. Unfortunately, a survey of over a hundred references located only one relevant data source. This source did not pan out. Accordingly, the formulated model for the stand management feasibility study had to be revised to fit temporary plot data gathered for yield studies. Data of this type has recently been borrowed from foresters at Virginia Polytechnic Institute, and with the data roadblock resolved, the timber management study is now nearing completion.

Replanting harvested acreage and managing existing stands is a push up supply response to the overcutting problem. Replanting can greatly affect timber supply in the long run, but will have little impact for the first 25 to 35 years. Management of existing stands gives a more immediate response, but it also has a much smaller impact on total supply. The overcutting problem on Maryland's Eastern Shore may be enough to defeat efforts to solve it by increasing supplies. Consequently, an economic base study has been started to determine the economic impact on the local level of a partial or complete exit of the Eastern Shore's timber-based industries. This study is approximately 70 percent completed.

Once the management feasibility and the economic base studies are completed, their findings will be combined with the drain study and with other published information. The combination should yield a more overall view of the Eastern Shore's pine resource situation, and should complete this project.

Project No. A-18-BF

EFFECTS OF TAX POLICIES ON FORESTRY
PRODUCTION IN MARYLAND

This project is concerned with determining the effects of alternative tax policies on production and marketing of forest products; determining the extent of multiple uses of forests and woodlands in Maryland including production of tree products, recreation, conservation and environmental protection; and developing alternative tax policies which would most likely stimulate forest and woodland uses of land.

About 40 percent of the total land area of the state is in woodland and forests. This includes woodlands as a part of farms, public forest and parkland, and commercial forests not in farms.

In 1963, the Maryland Legislature enacted a law which specified that forest and woodland tract owners of five acres or more could have assessed valuations of such land frozen at current levels until the date of harvest, if the landowner would contract with the State Department of Forests and agree to follow specified practices. At the date of harvest, sale of the land, or development of the land for other uses, a form of roll-back taxes becomes due and payable. Essentially the roll-back would represent the average of the tax rates since the date of contract times the average assessed value at the time the contract was signed and the assessed value at the date of harvest times the number of years elapsed. To date, less than 3,000 acres of woodland have been placed in the program.

Hypothesized reasons for the lack of participation in this program were: (1) Landowners are unaware of this opportunity and the effects this would have on earnings from forestry production, (2) Assessed values of woodland have not been rising as in the case of assessments on other land, (3) A large part of the woodland may be assessed according to farm use value rather than market value and (4) Costs of participation in the program may be greater than benefits received by forest land owners through "frozen" assessed valuations.

Data collected in 17 Maryland counties for 1971 indicated that about 217,000 acres of forest lands were assessed according to market value while 1.1 million acres were assessed according to farm value in the same counties, (Table 1). It is likely that much of the acreage assessed according to market value was assessed at a higher rate, because of the recreational use value of the land rather than the productivity of the land for producing forest products.

Table 1. Acreages of Forest Land And Average Assessed Valuation Per Acre, 17 Counties of Maryland, 1971.

Basis for assessment	Acreage	Assessed value per acre
Market value	217,399	$200.02
Farm use value	1,108,943	24.17

The data in Table 1 also support the hypothesis that forest landowners have failed to participate in the Forest Land Assessment Program because they would have little to gain as long as it remains to be assessed according to farm use value.

Project No. A-18-BH

PROFITABLIITY OF COMMERCIAL SOD PRODUCTION IN MARYLAND

This study dealt with production, harvest and transportation of commercial turfgrass in Maryland. Turfgrass producers were divided into four size groups for which average total costs of production were computed. Costs for three alternative harvest techniques and two methods of transportation were developed to provide a basis for computation of the cost structure of vertically integrated firms. Returns from alternative methods of sale (per acre, per yard - f.o.b. farm and per square yard - delivered to the buyer) were compared with production costs on the four sizes of farms and costs associated with different levels of vertical integration to determine the most profitable size of farm as well as the most profitable combination of farm size, harvest technique and method of transportation.

Production

There were 11,590 acres of commercial turfgrass under cultivation by 63 growers in 1968. Of this acreage, 3,739 acres were harvested, resulting in gross farm income from turfgrass production during 1968 equaling $2,968,194. During 1969, cultivation increased to 12,732 acres with an accompanying increase in farm-level income to $3.3 million.

Cultural practices, labor requirements and production costs for a two-year cycle were discussed and analyzed. Major emphasis was placed on the average costs, variable and fixed, of producing turfgrass by alternative sizes of farms. The smallest farms, those with less than 100 acres of turf, incurred the highest average total cost of production, $294.33 per acre. Farms with between 151 and 300 acres of turf were able to produce at a minimum computed cost of $255.00 per acre. The average total cost of production on farms exceeding 300 acres, the largest examined, was $278.04. On farms with 100 to 150 acres, the cost per acre was computed to be $269.21.

Average fixed costs for machinery, equipment and buildings declined steadily from $109.65 per acre, when farm size was less than 100 acres, to $57.86 per acre on farms with more than 300 acres.

Supervisory expense increased from $3.42 per acre on the smallest farms to $28.56 per acre on the largest farms. Included in supervisory costs were (1) Labor expense for travel time to fields, (2)

Day-to-day administration and (3) Time spent negotiating with purchasers of sod, both before and after harvest, and coordinating the harvest program. Supervisory expense increased with the size of farm, because of the prevalence of hired foremen on larger farms, separation of turf fields and the more time-consuming sales and negotiation techniques which were necessary to assure a market for a greater output.

In general, it was found that the largest farms were more efficient in their use of labor than the smallest farms. However, the decrease in production labor did not lead to a reduction in production labor expense. Wage rates, which averaged 40 percent higher on the largest farms than on the smallest farms, resulted in almost constant production labor expense for all sizes of farms.

The cost of variable supply inputs (seed, fertilizer, top-dressing, herbicides, lime and interest on variable capital) declined gradually from $106.21 per acre on farms with less than 100 acres to $99.92 on farms with 151 to 300 acres. The cost increased to $118.29 on farms with more than 300 acres. Farms with more than 300 acres typically employed more variable capital inputs in their production process in an attempt to produce a better quality grass than was produced on the less intensive operations of competing growers. The majority of growers with more than 300 acres harvested a portion of their acreage and realized that the better quality grass was easier to harvest, easier to market and could command a premium price.

Harvest

Three harvest systems were analyzed to determine average costs and compatability with different farm sizes. Labor expense for harvest and handling was reduced from 7.26 cents per square yard when harvest was performed by hand-directed equipment and sod was hand rolled to 4.55 cents with tractor-powered harvesters in combination with palletized handling. Part of the cost reductions which accrued to automated techniques were offset by increases in machinery and equipment costs which, in addition to sales and administrative costs, resulted in total cost per square yard of 9.257 cents for the automated procedure and 10.853 cents for the labor-intensive harvest system. The costs of harvesting and handling by tractor-powered harvesters and palletized handling versus tractor-powered harvesters and hand rolling were 9.257 cents and 9.303 cents per square yard, respectively. This indicates that labor cost reductions associated with palletized handling were almost offset by increases in costs for replacement pallets and specialized handling equipment (forklift trucks).

Transportation

Costs associated with two methods of transportation were analyzed to provide input for development of the cost structures of vertically integrated turfgrass operations. Sod was transported on trucks designed primarily to handle 650 to 700 square yards of palletized sod at an average cost of 5.121 cents per square yard and on trucks with a 350 to 400 square yard capacity at 6.633 cents. Both of these estimates were based on full-load assumptions. The estimates of cost increased directly with the number of stops and inversely with the volume delivered to each destination.

Return to Management

Return to management was presented for all combinations of farm size, harvest technique and method of transportation, including the options to sell unharvested turfgrass, sell f.o.b. at the farm and purchase by the acre for eventual harvest and transport. Under industry conditions which prevailed during 1968, farms with between 100 and 150 acres earned the maximum return to management from sale by the acre, $64.12 over a two-year period. Farms with less than 100 acres incurred the highest production costs and received the lowest price per acre which combined to yield the least return to management for a two-year period, $9.83 (Table 1).

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[1]The figure for harvested sod is based on an average price fo 25.5 cents per yard and expected yield of 4,600 yards per acre.

Sale of harvested turfgrass, f.o.b. at the farm, increased gross receipts per acre from an average of $340.00 for unharvested sod during 1969 to $1,173.00 for sod cut and loaded at the farm.[1] Of the realistic combinations of farm size and harvest technique, farms with more than 300 acres earned the maximum return to management, 9.897 cents per square yard, when harvest procedures included tractor-powered equipment and palletized handling. Assuming that small farms (less than 100 acres) harvesting and handling by hand could receive a price equal to that received on the largest farms (25.5 cents per square yard), their return to management from sale of sod f.o.b. at the farm was 7.930 cents per square yard, $364.47 per acre. However, it seems likely that small farms would have to improve the quality of their product in order to receive this price, thereby incurring increased production costs and decreased returns to management.

Table 1. Return to Management from Sale of Turfgrass by the Acre, Maryland 1968[a]

Item	Farm Size (Net Acres of Turf)				
	Less than 100 Acres	100–150 Acres	151–300 Acres	Greater than 300 Acres	All Growers
	$/Acre	$/Acre	$/Acre	$/Acre	$/Acre
Gross Receipts Per Acre	304.16	333.33	311.60	340.25	316.77
Less Variable Cost Per Acre Including Hired or Operator Labor, Equals	147.26	143.91	137.67	157.62	146.14
Return to Land, Fixed Capital and Management	156.90	189.42	173.93	182.63	170.63
Less Fixed Costs Including 7% on Fixed Capital and $34.00 Land Rental Rate, Equals	147.07	125.30	117.30	120.42	127.95
Return to Management	9.83	64.12	56.63	62.21	42.68

[a]Two-Year Production Period.

Individuals who elected to harvest and transport sod to the buyer received an average price of 32.5 cents per square yard in 1969. Of those who marketed their turf by this method, growers with more than 300 acres who harvested with the most automated techniques and transported the pallets on large trucks with an average capacity of 675 square yards earned the maximum return to management, 11.776 cents per square yard. Other combinations of farm size, harvest system and method of transportation showed a greater return to management, but these were believed to be in excess of what could have been earned on these farms under industry conditions prevailing during 1969.

Project No. A-18-BD

INPACT OF PRODUCTION, HARVESTING AND PROCUREMENT OF MARKET STRUCTURE OF THE NORTHEAST FISHING INDUSTRY

During the initial phase of this project's execution, efforts were focused on the development and pretesting of an interviewing questionnaire. This questionnaire facilitated the isolation of production costs and the product flow for oyster products. After pretesting, 24 of the 54 firms that shucked oysters in Maryland during 1971 were interviewed. Collectively, the firms contacted

processed over one million of the two million gallons of oysters landed in Maryland during 1970-71 season. Of the total quantity of oysters processed in Maryland, the same group of firms were found to account for over 70 percent.

Over 34 percent of Maryland's 1970-71 production of shucked oysters was shipped to Mid-Western states. Chicago was the largest receiver, accounting for over 13 percent. The second highest receiving region was New England with 11 percent. The Mid-Atlantic states received eight percent. The Southern and Western states received seven and nine percent, respectively. Of the remaining 29 percent, 13 percent was retained by the Chesapeake Bay states, two percent was shipped to Canada, and 14 percent was unallocated.

Processing costs were broken down into four categories. Cost of raw materials was found to account for 12, 25, and 3 percent, respectively.

An assessment of the economic feasibility of farming catfish in Maryland was also undertaken during 1971. Pond culturing of catfish, given present prices and the state of the art, was found to be financially disastrous in regions requiring in excess of 1.5 years to grow a catfish of marketable size. Net returns accruing to growers in these regions were estimated to be negative.

At 36 cents per pound, net returns accruing to Mississippi and Arkansas fish farmers were estimated to be $85 per acre. For Kansas, Maryland, and New York, net returns per acre were estimated to be $-\$435$, $-\$469$, and $-\$841$, respectively.

During 1972, 24 of the 105 firms that shucked oysters in Virginia were interviewed to isolate the out-of-state flow of oyster products. Collectively, the firms contacted, processed over 750,000 of the two million gallons of oysters shucked in Virginia during the 1971-72 season.

Over 60 percent of Virginia's 1971-72 production of shucked oysters was shipped within the South-Atlantic states region. Roughly 80 percent of the 60 percent stayed in the Maryland-Virginia area. The second highest receiving region was the Mid-West with 20 percent, followed by the Mid-Atlantic states which accounted for approximately 10 percent. The West-Coast, Canada, and the New England region accounted for four, two and two percent, respectively.

In addition, oyster processing firms located in the southern and western United States were contacted, thus completing work on the oyster product flow.

Also during 1972, a study was undertaken to determine the economic repercussions of imposition of a limited entry management scheme upon the Maryland oyster fishery. Because of the limited nature of the study, only four communities were selected for analysis—Shady Side, Rock Hall, Crisfield-Smith Island and Avenue. Using information collected in interviews with oystermen living in the four communities, in combination with local labor market outlooks, an appraisal was made of employability. In specific, it was determined that Shady Side and Avenue had the largest number of potentially employable watermen. Rock Hall and Crisfield-Smith Island had relatively few. The lack of employable watermen in the latter two communities was attributed to the lack of marketable skills.

The economic repercussions of limited entry were developed for elimination based on earnings per hour and time spent oystering. In order to gauge the responsiveness of costs and benefits to alternative relocation strategies, economic effects were derived based on: a) Opportunity costs being greater than hourly oyster earnings; b) Hourly earnings being less than $6 for vessel owners and $2.50 for non-owners; c) Exclusion of part-time watermen; and, d) Elimination of all oystermen who spent less than 360 hours harvesting oysters per season.

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Of the restrictive strategies used, relocation based on earnings being less than $6 for vessel owners and $2.50 for non-owners, respectively, part-time status and time spent being less than 360 hours were the management schemes incapable of producing favorable results across all four communities. However, selected communities were found to benefit given exclusion based on these three strategies.

Work was also completed on an economic profile of the fisheries of the Chesapeake Bay.

A Frequency of Licensed Oystermen Interviewed

Table 1. Age Frequency of Licensed Oystermen Interviewed

	Age							
Location	1–18 Yrs.	19–24 Yrs.	25–29 Yrs.	30–34 Yrs.	35–44 Yrs.	45–54 Yrs.	55–64 Yrs.	65+ Yrs.
Shady Side	0	1	5	6	7	5	2	3
Rock Hall	5	0	4	6	5	8	5	8
Crisfield- Smith Island	0	4	3	2	5	7	4	5
Avenue	0	4	3	2	5	7	4	5
Total (all areas combined)	4%	7%	11%	14%	18%	20%	14%	13%

Project A-26-CF

PROJECT REPORTS

AGRICULTURAL ENGINEERING

AGRICULTURAL ENGINEERING

Agricultural engineering research is concerned with helping to meet the growing demands for: greater production of food and natural fiber; more emphasis on improvement and/or maintenance of the environment; and the need to improve the standard of living for the rural population. Scientific and engineering principles are used to develop new facilities, equipment and/or methods to: conserve and utilize our soil and resources for food production and recreation; enhance and maintain a high quality environment; apply energy to improve labor efficiency and to reduce laborious and menial tasks in the production and processing of feed, food and fiber products; house or handle plants and animals to optimize growth potential; improve the residences of the rural population; and maintain or increase the quality of feed, food and natural fiber in the flow of products from the production units and/or processing plants to the consumer.

Because engineering problems exist in all disciplines of agriculture, most research is conducted in cooperation with scientists in other disciplines. The summaries which follow indicate this close cooperation and their efforts are recognized. There also exists both a formal and informal use of agricultural engineers as consultants on the engineering aspects of research throughout the Agricultural Experiment Station.

PHYSIOLOGICAL RESPONSE OF CHICKENS TO VARYING ENVIRONMENTS

Evaporative Cooling

A series of studies comparing conventional housing, windowless housing and housing with evaporative cooling showed that environmental chambers equipped with evaporative cooling could be maintained at 10 to 14 deg. F cooler than under windowless or conventional conditions, when the outside temperature exceeded 90 deg. F.

The feed conversion and mortality was best in the evaporatively cooled chambers. The weight was about the same in evaporatively cooled and windowless chambers, however, birds grown under conventional conditions were about 0.10 pounds lighter.

Temperature Studies

Research with three starting temperatures (85, 90, 95 deg. F) and three rates of temperature reduction (2 deg./day, 5 deg./week and 10 deg./week each to 70 deg. F) were conducted with commercial broilers grown from day old to eight weeks.

There was no significant difference in the treatments for mortality or feed conversion. There was a difference for fuel use in favor of the lower starting temperatures and faster rates of temperature reduction.

The heaviest birds were grown at 90 deg. F starting temperature with a 2 deg. per day temperature reduction. The average bird weights were only 0.02 and 0.03 pounds higher than birds started at 95 deg. F with a reduction of 10 deg. F per week and 85 deg. F with a reduction of 5 deg. F per week, respectively. These differences were not significant.

The birds having the lowest percent fat were those started at 85 deg. F with a 5 deg. F per week reduction.

From a management and production point of view, it appears that a starting temperature of 85 deg. F and a temperature reduction of 5 deg. F per week would be the most satisfactory for growing broilers in windowless houses in Maryland.

Project No. MD-RM-2

MECHANIZATION OF TOBACCO HARVEST

The University of Maryland Agricultural Engineering Department has developed a tobacco harvester which will satisfactorily cut and convey tobacco plants onto a wagon or pallet for spearing at the barn or some central spearing area. The harvester is mounted on the three point hitch of a two to three-plow tractor and is powered by the tractor P.T.O. which drives a hydraulic pump operating the necessary motors. The hydraulic power system has the advantage of allowing the operator to vary speed control independently for the various working parts of the machine. Speed control is regulated by the use of a variable volume pump. The hydraulic system of the tractor is used to adjust the height of cut and to raise the harvester for turning and transporting.

There are two major parts to the operation of the harvester: first is cutting and second is lifting the plant. Cutting is accomplished through the use of two overlapping 16-inch diameter round plow coulters mounted parallel to the ground. One coulter is notched and driven by a hydraulic motor, the other is smooth and free to turn when the plant is cut. Research has shown that the speed of the driven coulter should be approximately 1.2 times the ground speed. Corn picker lifters are mounted ahead of the coulters and lift the bottom leaves to prevent damage during cutting.
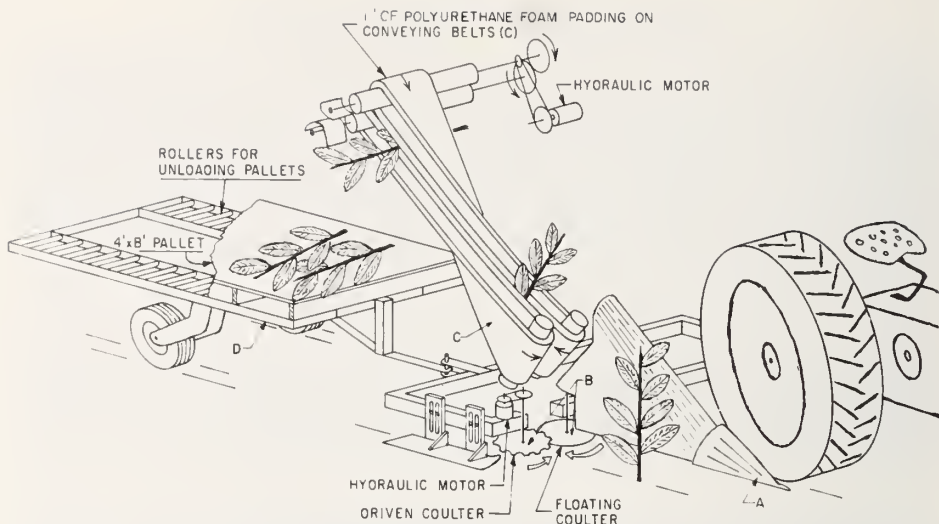
The unique feature of the harvester is the belt system used to convey the cut plants onto the wagon and rotate the stalks from vertical to a horizontal position. This system of belts consists of two 18-inch wide neoprene belts padded with one inch of polyurethane foam cushioning. This soft and springy foam holds the plant with minimum bruising or breaking of the leaves. Belts can be adjusted for variation in size of tobacco from field to field.

As the plant is cut, it is caught between the two belts. The belts hold the plant in the upright position and move it upward at an angle of approximately 45 deg. until elevated to a height of six feet. While the plant is being elevated, the belts twist one quarter turn which rotates the plant to a horizontal position for deposit on a pallet or wagon. A hydraulic motor drives the belts at approximately twice ground speed. This moves the freshly cut plants away from the cutting point quickly and eliminates interference with the next cut plant.

The cut plants can be transported to the spearing area by several means. A two wheel trailer carrying a four foot by eight foot pallet, shown by D of Figure 1, will carry from 150 to 200 plants. When the pallet is full, the trailer is tilted by lifting the harvester with the three point hitch. Rollers on the trailer allow the pallet to slide off on the ground where plants can be speared and loaded. Here only two men are required, the tractor driver plus one loader. If plants are to be speared in the barn, pallets can be picked up and transported with a rear mounted fork lift on a farm tractor. The fork lift works satisfactorily if the spearing area is less than one quarter mile from the field; otherwise, the time spent hauling is too great. This method requires an extra man to operate the fork lift.

A second method is to load the cut plants on a two wheel trailer or four wheel wagon hitched behind the harvester. These should be about eight feet wide to allow two rows of plants. The operation requires two men to stack the tobacco on the wagon or trailer. Larger wagons have a capacity of 600 to 1,000 plants and are more efficient when barns are further from the field. The tobacco is stacked from back to front in regular order with the butts out to facilitate spearing.

The harvester is operated between one and two miles per hour. The machine will, if operated continuously, harvest 38 to 75 plants per minute. However, time must be allowed for turning at the end of the row and changing of the wagons when full. This time loss will vary depending on the length of the rows and layout of the field. Actual measurment for a three and one-half acre field harvested at the Tobacco Experiment Farm resulted in an average time of 35 plants per minute (approximately three hours per acre).

' CF POLYURETHANE FOAM PADDING ON
CONVEYING BELTS (C)

HYDRAULIC MOTOR

ROLLERS FOR
UNLOADING PALLETS

4'x8' PALLET

D

C

B

HYDRAULIC MOTOR
DRIVEN COULTER

FLOATING
COULTER

A

SCHEMATIC OF TOBACCO HARVESTER

FIGURE 1

Project No. MD-R-11-H

DEVELOPMENT OF EQUIPMENT AND IMPROVED
METHODS FOR HARVESTING SWEET POTATOES

During the 1969 field tests with the two row self-propelled prototype sweet potato harvester, the mechanical performance of the machine was excellent. Ratings of potatoes for the fresh market that were machine harvested, cured and stored under good conditions, indicated an average of 71 percent were marketable. Four varieties, Redmar, Rose Centennial, Goldrush and Nemagold, were harvested.

To reduce damage to potatoes discharged from the machine, two methods were used. A pallet box with an adjustable bottom that could be raised and lowered to maintain a constant drop distance, and a pallet box lined with plastic and one-third filled with water to provide a cushioning effect for the falling potatoes. The latter method resulted in lower damage to the potatoes.

This project was terminated June 1970. During the period covered by this project, a new method, called the "once over" operation, for harvesting sweet potatoes was developed. A conventional digger chain was used for elevating and conveying the soil and crop across a 60 inch horizontal section to separate soil from the crop. Most of the soil was retained on the elevator section to reduce damage to the potatoes. The crop was discharged onto a 52 inch conveyor made of one-half inch diameter bars spaced six and three-quarters inches apart. A vibratory motion by the conveyor detached potatoes from the vines. Potatoes that were not detached by the motion of the conveyor were removed by a rigid bar and roller combination mounted at the rear of the conveyor.

The successful performance of the techniques developed has led to their acceptance and use by industry in machines used to harvest canning stock.

Two Row Self-Propelled Sweet Potato Harvester

Adjustable pallet
(Score: 92)

Condition of Mechanically Harvested Nemagold Sweet Potatoes after Four Weeks of Storage (Adjustable Bottom Pallet)

Condition of Mechanically Harvested Nemagold Sweet Potatoes after Four Weeks of Storage (Scored on the Basis of 1 to 10) (Water Pallet)

Project No. R-18

DEVELOPMENT AND CONSTRUCTION OF SPECIALIZED FACILITIES AND EQUIPMENT USED IN AGRICULTURAL RESEARCH

Pictures D, E, F and G illustrate the on-going work of this project.

Project No. MD-R-21

(pages 59 and 60)

Picture D. Snap bean harvester in operation. Note elevator is enclosed and beans are treated as they move up elevator. Work in cooperation with Horticulture Department.

Picture E. Equipment was designed and constructed to treat snap beans with a reducing gas to control brown end. Equipment being adjusted on bean harvester.

Picture   F.   Environmental chamber constructed for Agronomy
              Department to study the effect of air pollution on
              plants.
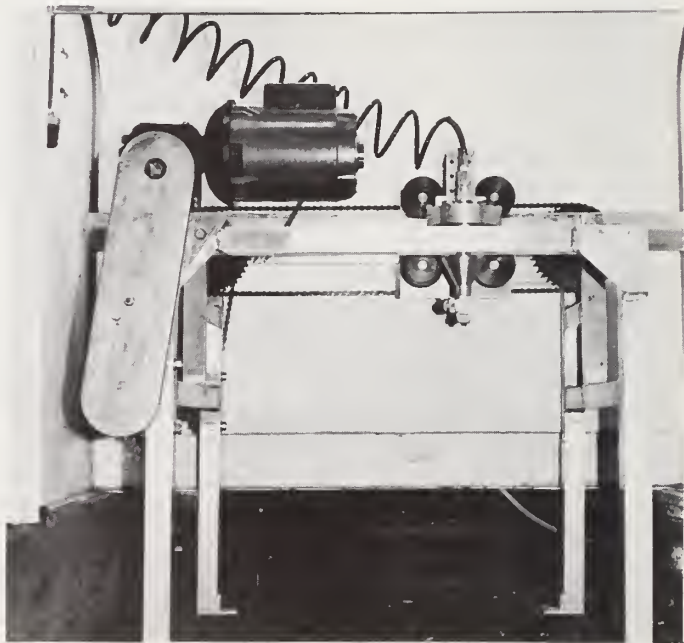
Picture   G.   Laboratory sprayer for application of pesticides on
              greenhouse flats. Studies being conducted by the
              Horticulture and Agronomy Departments.

APPLICATION OF ENERGY FOR CONTROL OF INSECTS

This project was terminated June 1970. The objective of the project was to investigate the feasibility of thermal control of the alfalfa weevil. Laboratory studies were conducted to determine the time-temperature exposure factors related to mortality of alfalfa weevil adults and eggs. Based on results obtained from laboratory studies, equipment for field application of controlled heat was developed. Field studies were conducted to determine the optimum conditions for most effective use of flaming in relation to other cultural practices. Flame treatments were compared with untreated and/or standard insecticide treated checks.

The following major conclusions are based on data obtained from this project:
1. Flaming, both dormant and stubble alfalfa, was effective in reducing weevil populations.
2. High intensity flaming resulted in reduced alfalfa yield and plant stand.
3. Flaming new seeding of alfalfa caused reduced stands, reduced vigor of plants and lower yield.
4. Flaming of established alfalfa with new growth resulted in reduced weevil control and yield.
5. Both dormant and stubble flaming resulted in lower fiber and higher protein content of plant material. The increase in quality permitted one cooperator to develop a new market outlet.
6. Flaming reduced the growth and vigor of chickweed.
7. The best results achieved with the experimental flamers were equivalent, in terms of weevil control and alfalfa yield, to standard spray application of methoxychlor-malathion.
8. The 1968 experimental flamer demonstrated cost economics competitive to insecticide spray. In addition, cooperators indicated that flaming also reduced management decisions and anxiety normally experienced with insecticide mixing, sprayer calibration, application and dispersion.

Project No. RHB-23

A HIGH PRESSURE STEAM PEELER
FOR FRUITS AND VEGETABLES

A batch peeler using time-regulated, high-pressure steam was designed and constructed by the Agricultural Engineering Department. (Figure 2)

Tests were conducted with three varieties of sweet potatoes to yield information on time-pressure relationships required for effective peeling using the experimental steam peeler. Indices for evaluating treatment effects were (1) The effectiveness of removing the peel, (2) The loss in weight of the potato and (3) The degree of discoloration caused by enzymatic darkening.

Results of the experiments with sweet potatoes avoided the occurrence of the explosion phenomena encountered with conventional high-pressure steam peelers. This resulted in effective peeling with minimal enzymatic discoloration of the product.

Project No. MD-RQ-28

DISPOSAL OF WASTE FROM SWINE FEEDING FLOORS

The objective of this investigation was to determine the effectiveness of the soil mantle as a receptor for the concentrations of nutrients and organics in periodic high-rate flood applications of liquid swine wastes. To attain this objective, the quality of the percolate water existing in the soil under the waste water flood conditions was monitored, and residual effects from the waste water applications were examined.
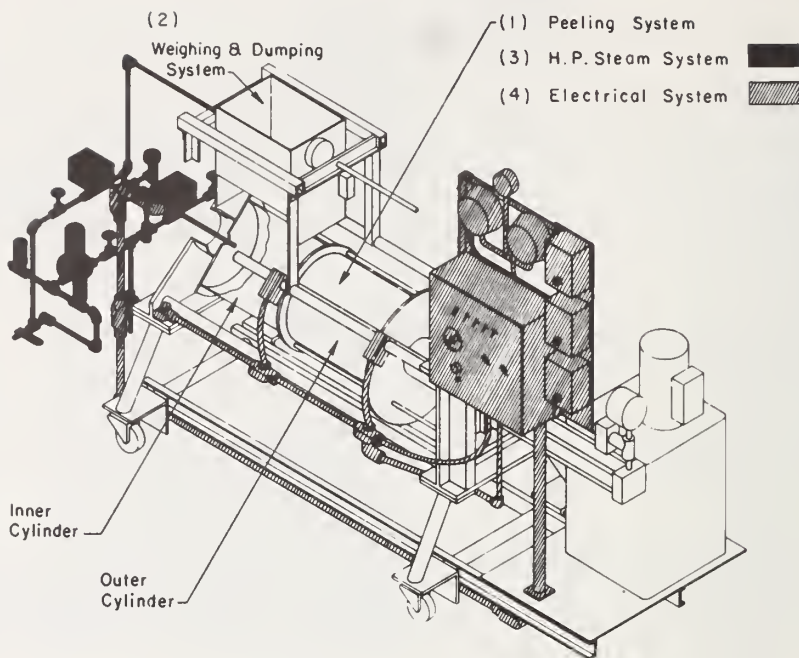
FIGURE 2

Project No. MD-RQ-28

The trench-type zero-tension lysimeter shown in Figure 3 was constructed in 1969. The 0.6 meter wide trench was cut with a backhoe in a Comus silt loam soil. As it was cut, the trench walls were lined with plywood and supported with framing. The trench was 60 meters long and ranged from 1.2 to 2.5 meters in depth.

Surface plots on either side of the trench were prepared by forming small earth berms around a 9.6 square meter area. 26 plots were formed in this manner. The interior of the plots were graded level and seeded with orchard grass.

Four holes were bored through the plywood wall facing each plot. Soil cores five centimeters in diameter were cut horizontally into the soil profile through each hole to a distance of 1.5 meters. PVC pipe was forced into each hole as far as it would reach.

The inner 30 centimeter section of each pipe was slotted to allow percolate water to enter as in a tile drainage system. The remainder of the pipe was closed to water inflow. Thus, water samples were taken from beneath the center of the plots.

The effective depths of the sample tubes were 25, 50, and 75 centimeters with a fourth tube as deep as the trench cut would allow. Samples from the fourth tube were not used because the existing water table was generally at or near that level.

The sample collection system provided samples only when the soil in the area of the sample tubes was saturated. Thus, samples appeared only after irrigation or significant rainfall. Percolate samples were collected in one liter plastic bottles as shown in picture H.

The experiment was performed in two phases. Phase I observations compared the effect of four different application rates of the liquid swine wastes. Flood depths of 2.5, 5.0, 7.5 and 10.0 centimeters were selected as treatment levels. 12 plots were randomly assigned the treatment levels such that four groups of three replicates were formed. Application, sample collection and analysis occurred once each week between July and November 1970.

Phase II of the experiment compared the effect of a 7.5 centimeter flood of liquid swine wastes with a 7.5 centimeter flood of tap water. Application occurred once each week between July and November 1971.

Applications occurred on Mondays and all percolate sample analyses were completed by Friday of the same week. Rainfall samples were included when possible and were usually tested within one week of collection.

Analyses included the following:
1) Chemical Oxygen Demand (COD) MG/L
2) Ammonium Nitrogen (NH_4) MG/L
3) Total Phosphate (TP) MG/L
4) Chloride (Cl) MG/L
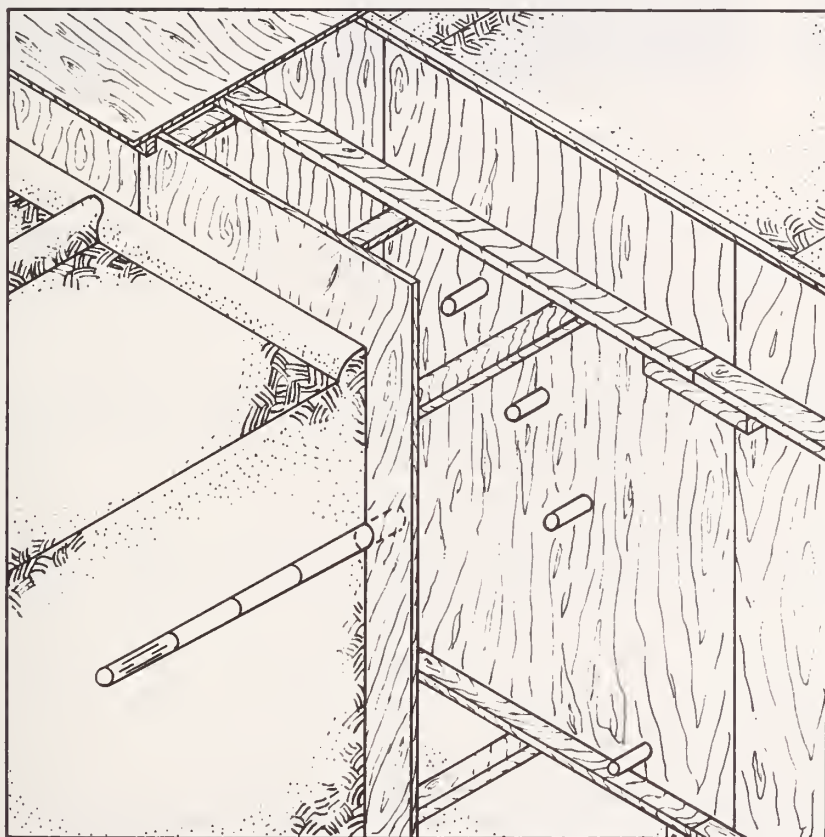5) Sulfate (SO_4) MG/L

FIGURE 3. SECTION VIEW OF TRENCH LYSIMETER

Picture H. Sample Collection on the Trench Lysimeter

Under the conditions generated by the periodic high-rate flooding with swine waste water, the Comus silt loam soil did not sufficiently remove organics and nutrients to a degree necessary for the prevention of ground water contamination. Percolate water from the saturated soil profile during and directly after flood application of swine waste waters retained relatively high concentrations of contaminants as it moved through the soil.

The zero-tension type lysimeter collected soil percolate water only when the volume of soil around the collection tube was saturated with water. When the surface of the soil was flooded, the infiltrating water followed the path of least resistance. In the natural soil condition the existence of small fissures, root channels and other irregularities produced water paths similar to pipe flow. The existence of this pipe flow was very prevalent on the lysimeter.

The condition of pipe flow prevented any major renovation of the applied waste waters other than on initial mechanical filtering on the soil surface. After the waste water had entered the profile, the decrease in contaminant concentration was generally less than 40 to 50 percent.

The determining factor under those conditions was, perhaps, the volume of the application in terms of how much waste water readily moved to greater depths rather than how much renovation occurred. The effect was an immediate one lasting only as long as enough free water pressure was present to force the liquid to pipe flow.

The existence of small fissures, root channels and other irregularities in the soil produced water paths similar to pipe flow. Flooded waste waters would move in these channels with no major change in composition. Application of waste with high organic solids content would tend to clog the channels in the soil.

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Further investigation of natural soils as waste water treatment devices is necessary to allow adequate system design. The use of constructed soil beds and other soil structures as treatment devices that can be easily constructed, maintained and operated on the farm should be investigated. The long term preservation of the ground water quality under these systems should also be considered. This project was terminated June 31, 1972.

Project No. MD-R-29

APPLICATION OF ENGINEERING PRINCIPLES
TO SHELLFISH PROCESSING

An engineering analysis of the Maryland oyster industry was completed. A flow chart depicting each step in the oyster's life from spat set to market was developed. Time study measurements were taken on various processes in oyster processing. Including time for unavoidable delays, personal time and fatique time an average professional oyster shucker can shuck an oyster in 7.8 seconds. This engineering survey showed that the most pressing problem in the Maryland oyster industry was shucking the oysters. A shortage of shuckers, an inability of the industry to attract new shuckers and the fact that 70 to 80 percent of the labor in a shucking plant is consumed in shucking, all lead to a great need for automated shucking equipment.

Maryland oyster industry depends on oysters from the natural environment for the total supply. A result of natural production is wide variation in the biological properties of the oysters. Variation in shell shape, shell strength, meat condition and extent of fouling are but a few of the problems associated with automated shucking. For example, the mean thickness of one shell valve, measured at the adductor muscle point of attachment, is 0.23 inches, but the standard deviation is 0.068 inches. Shell length varies from three inches (lower limit of legal size) to over seven inches.

Shucking an oyster requires that the adductor muscle attachment to each shell valve and the oyster hinge be severed. Many techniques to accomplish the severing of muscle-shell bonds and the hinge were explored. Table 1 lists the various energy forms explored for shucking oysters or for accomplishing one segment of the process (e.g., severing the oyster hinge). Column 2 of the table summarizes the techniques used while column 3 shows the preliminary result.

Most of the techniques for shucking oysters (Table 1) can be rejected for some reason, e.g. damage to the meat, the technique didn't work, etc. However, for severing the adductor muscle-shell bond, radiant infrared energy and freezing, followed by partial thawing, were the most promising. A technique utilizing gas fired infrared heaters has been developed for releasing the oyster muscle-shell bond in a two step process. Further studies on freezing techniques will be carried out.

Of all the techniques studied for severing the hinge, forcing the hinge onto a conical point offered the most promise. A machine has been developed to utilize this technique. In the machine the hinge end of the oyster shell is trimmed by a masonary saw to expose the hinge; the hinge is not cut off by the saw. After the hinge is exposed, an automatic sensing and positioning system consisting of photoelectric components, an integrated electronic circuit and an air and oil hydraulic system align the conical point with the oyster hinge. The hinge is then driven onto the point and severed.

Oysters entering the shucking machine are first oriented and placed by hand on the first heating conveyor. This conveyor releases the adductor muscle from one shell valve. The osyter, after passing through an automatic reorienting device, enters the hinge severing section of the machine. Here the hinge end of the shell is trimmed to expose the hinge. The hinge is severed and one shell valve is rejected. The oyster-on-the-half-shell exiting from the hinge severing section is turned over, and passes into a section which causes the oyster meat to be washed free from the shell except for

IMPACT OF EXTENDING UNEMPLOYMENT
INSURANCE TO MARYLAND AGRICULTURE[a]

Impact Variables		Coverage Alternatives				
		Universal Coverage[b] 1 in 1	1 in 20 or[c] $1,500	4 in 20 or[d] $5,000	4 in 20[e]	8 in 26[f]
Amount of Employment						
Gross Payroll	#	$24,300,300				
	%	100	99	65	58	35
Man Weeks	#	380,800				
	%	100	98	56	52	29
Wage Items	#	22,700				
	%	100	93	53	44	19
Seasonal Wage Items	#	16,800				
	%	100	90	51	40	14
Number of Employers and Workers and Beneficiary Status of Workers						
Employees Covered	#	2,900[g]				
	%	100	90	17	14	3
Workers Covered	#	19,400				
	%	100	95	53	44	19
Potential	#	16,300				
Beneficiaries	%	100	99	67	67	52
Actual Beneficiaries	#	1,700				
	%	100	100	100	94	82
Benefit Exhaustees	#	300				
	%	100	100	100	100	80
Financial Aspects of Coverage						
Taxable Payroll	#	22,171,000				
	%	100	99	64	58	35
Employer	#	709,500				
Contributions	%	100	99	64	58	35
Benefit Payments	#	350,300				
(added)	%	100	99	98	67	47
Cost Rates (added)	#	1.58	1.61	2.59	1.93	2.07

[a]The percentage figures given under the five coverage alternatives represent what proportion of the absolute figure given for universal coverage would be covered under each of the other provisions.

[b]One or more workers in one or more weeks.
[c]One or more workers in 20 or more weeks or a $1,500 high quarter payroll.
[d]Four or more workers in 20 or more weeks or a $5,000 high quarter payroll.
[e]Four or more workers in 20 or more weeks.
[f]Eight or more workers in 26 or more weeks.
[g]Because of limitations in the sampling procedure, this figure is known to be an understimate.

the muscle attachment. At this point the oyster meat hangs from the shell valve by only the muscle attachement. On the last section the shell forms a bridge between two parallel conveyor chains with the meat hanging between the chains. Heat applied to the outside (upper) shell surface causes the muscle-shell attachment to be severed. This allows the meat to fall into a collecting area. The shell valve is discarded at the end of the conveyor chain.

Washed oysters are more sanitary to handle than unwashed oysters. Thus, an oyster (shell stock) washing machine has been developed. This device removes the mud and most of the fouling from the exterior of the oyster shells.

Studies of the reaction of the oyster shell-adductor muscle attachment to several parameters has been studied. The parameters studied were: (1) amount of time oysters were held in refrigerated storage (34 deg. F) before shucking, (2) shell thickness, (3) amount of time oysters were soaked in tap water just prior to heating, and (4) heating temperature. A mathematical model was developed relating these four variables to the amount of time the oyster must be heated to induce muscle detachment. The model is:

$$\text{In (H.T.)} = 8.64 - 0.876 \ \text{In} \ T + 2.67 \ (TH) - 0.00013 \ (D)^3 - 0.00029 \ (S.T) \qquad (1)$$

where, | H.T. | = | Heating time in seconds
| T | = | Temperature in ^0C
| TH | = | Shell thickness in inches
| D | = | Length of storage time in days
| ST | = | Soaking time in minutes
| In | = | Natural logarithm

This model resulted in a multiple R of O 0.5874. Neglecting the last two terms of equation gives:

$$\text{In (H.T.)} = 8.64 - 0.876 \ \text{In} T \qquad (2)$$

The multiple R of this equation is 0.5840. Considering the small change in the multiple R value between equation 1 and 2, equation 2 might be more useful from a practical standpoint.

Project No. MD-R-30

CURING AND STORAGE OF MARYLAND TOBACCO

The present method of spearing and lifting tobacco up into a barn was changed to reduce labor in harvesting and housing, and also to give better control of the curing environment. These changes resulted in the development of a curing system called "compact curing". This system of curing consists of packing or hanging the tobacco on one tier approximately four to five times closer than is now practiced in conventional barns. This does away with lifting tobacco up in the barn. The tightly packed tobacco is then cured through the use of forced air and supplemental heat when needed. The results of this system have been satisfactory and good quality Maryland tobacco has been produced. However, with the relative high investment in equipment for a complete facility, studies were made to shorten the curing time and increase the number of times a facility could be used each season.

One of the techniques tested treated fresh cut plants with ethylene gas. Approximately 2,000 fresh cut tobacco plants were treated with ethylene gas in a plastic covered compact curing facility. For a period of 48 hours the gas was used at a concentration of 1,000 ppm in an effort to accelerate the ripening of the plant. There was no indication that the gas increased the rate of ripening or yellowing of the plant.

Another technique tested to accelerate ripening was the use of ethylene releasing growth regulators. Plants were field sprayed after topping. These tests were conducted for three seasons

with results improving each season. For this chemical to be effective the tobacco must have reached a mature stage. Green immature tobacco sprayed with the regulator produced nonuniform ripening. This means the tobacco has to be either topped low or topped and allowed to remain in the field long enough for the top leaves to mature. The tobacco should be harvested two to three days after treatment. Full yellowing of the entire plant in the compact curing facility occurred in three to four days for the sprayed plants. The unsprayed plants required seven to ten days. All the leaves of the sprayed plants would be yellow with little browning of the bottom leaves while with the control plants, one-third of the plant would be brown, or cured, before the top leaves became yellow. The quality of the leaf has no visible changes due to the treatment. Chemical analysis showed no difference between the treated and nontreated tobacco. Treatment of tobacco with ethylene has the potential of shortening the compact curing time of Maryland tobacco thus making the investment in equipment more feasible. This project was terminated December 1972.

Project No. MD-R-31

MECHANICAL HARVESTING OF SWEET POTATOES
FOR THE FRESH MARKET

The two-row self-propelled harvester developed by the Maryland Agricultural Experiment Station to harvest canning stock was modified to reduce the damage inflicted during the harvesting operation. To permit maximum concentration on evaluation of component performance, the modified machine was designed to harvest only one row.

Results from field tests in 1970 indicated an average of 91 percent of four varieties ('Centennial', 'Nemagold', 'Redmar' and 'Md 2262') mechanically harvested, using a water pallet bin, were rated in "Good to Excellent" marketable condition after several weeks of storage. Only 66 percent rated in the "Good to Excellent" category from tests using a standard pallet bin.

Results obtained in 1970, along with the need to size grade potatoes harvested with the Maryland machine, led to the development of an experimental system for handling potatoes collected in pallet bins carried on the harvester. The system included a water dump, a Lobee Washer or a brushless water spray washer designed by the Agricultural Engineering Department, inspection conveyors and a size grader.

Data from the 1971 tests indicated that mechanically washing the potatoes before storage had little deleterious effect on condition or on storage behavior. With the use of the water pallet bin, damage to the potatoes as measured by condition scores was held to a level almost on a par with plow harvested potatoes.

Preliminary data from the 1972 tests indicate similar results as obtained in 1971. The performance of the commercial size grader, which was added to the experimental line in 1971, performed satisfactorily with low damage inflicted to potatoes that were washed before being graded.

Although machine components of the experimental harvester continue to inflict injury, the level of injury associated with the digging, elevating, soil separation, potato detachment and separation from vines and root systems is probably as low as can be practically achieved. This is due to the difficulty of controlling these operations under varying field and crop conditions.

The most serious factor concerned with mechanized harvesting and handling may be the development of surface fusarium during storage. Injury and delay in placing potatoes in proper curing conditions predisposes the potatoes to infection by surface fusarium. This may be aggravated by using a water pallet and water dump. However, there is a need for more definite information on the nature of surface fusarium infection and its development.

Project No. MD-RQ-32

Single Row Sweet Potato Harvester

Single Row Sweet Potato Harvester

DESIGN AND DEVELOPMENT OF EQUIPMENT
FOR COMPOSTING AGRICULTURAL WASTES

Composting is the biological decomposition of organic materials by microorganisms. Under controlled conditions aerobic microorganisms predominate. This aerobic process does not produce offensive odors, and results in a more rapid decomposition of organic material than an anaerobic process can achieve.

Composting offers advantages not inherent to other biological waste treatment processes. Since composting treats the wastes in the solid state, there is no need for dilution water. There is less weight and volume of material to store, to handle and to transport. Several potential uses exist for composted wastes.

The type and rate of decomposition during composting is influenced by several factors. For dairy cow wastes, the most important factors appear to be the structure of the material and the aeration rate. Intermittent agitation and stirring of large quantities of materials dictate the use of a mechanized and, perhaps, automated composting system.

A laboratory composting channel was designed and constructed to investigate the concept of a semi-continuous flow composting system. An elevating mechanism was built and operated in the channel to counteract moisture migration and settling, and to move the waste material through the channel.

Tests were conducted, using both artificial test materials and actual dairy cow wastes, to evaluate the functional ability of the system. Different levels of elevator slope, elevator forward velocity and elevator chain speed were used to determine the effect of these parameters on the power requirements of the system. The power required to move the elevator through the channel was insignificant in comparison to the total power requirement.

Dairy manure composted in the channel reached a stabilized condition in 28-33 days. Aerobic composting of dairy manure with moisture in excess of 75 percent W.B. could not be initiated due to channeling of the air through the waste.

Following a series of three five-week test periods, several design modifications were made to the elevator to reduce friction and material adhesion and to increase elevator aggressiveness. Two extended tests were conducted to evaluate the functional ability of the redesigned mechanism.

Concurrently, a variation of the overall composting system was investigated. The composting waste was removed from the channel after 15 days to a programmed stockpile. This system modification, which results in increased channel throughput and reduced operating costs, is possible due to reduced aeration demand after the initial 10-12 days of composting.

The compost again stabilized in 4-4.5 weeks. Average weight and volume reductions of 60 percent and 39 percent, respectively, were attained. This system exhibited considerable potential for waste reduction and reuse of animal manures and is under further investigation.

Project No. MD-R-33

CONTROLLED SPINNER LOADING OF CENTRIFUGAL FERTILIZER SPREADERS

This project was initiated in 1970 to determine the influence of precise loading of the spinner of a centrifugal spreader on the coefficient of variation of the distribution pattern.

An analytical model relating the major spinner variables, particles characteristics and projectile motion was developed. The results obtained from the model were used to design a series of experimental tests. These tests were used to evaluate the performance of a spinner using known loading conditions with crystaline Potassium chloride and prilled 16-16-16 fertilizers.

Well-shaped distribution patterns with low coefficients of variation were obtained by utilization of eight closely defined loading areas and the regulation of the incremental flow rate to each of the areas. The metering, flow division and loading procedures developed should be readily adapted for field use.

Project No. MD-R-34
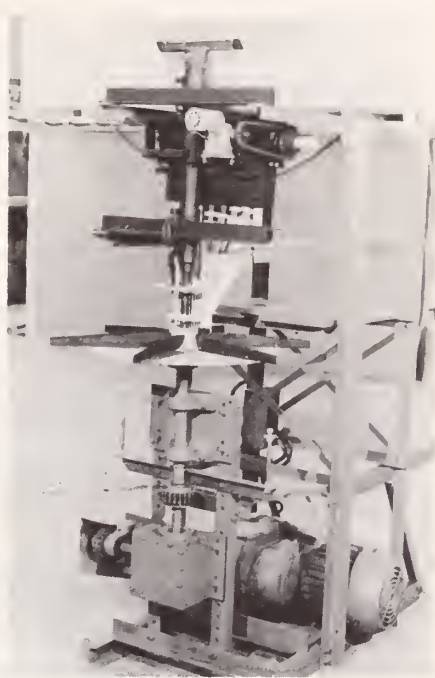
HORIZONTAL PNEUMATIC CONVEYING OF MIXED GRANULAR MATERIAL

The objective of the research project was to investigate the feasibility of increasing the efficiency of pneumatic conveying of mixed granular material. A series of experimental tests using mixtures of soybeans (York), vetch (Hairy) and rape (Dwarf Essex), and two pipe sizes, two-inch and three-inch diameters, were conducted.

The following major conclusions were drawn from the study.
1. Introduction of the fine material into the system carrying the coarse material produced a boost in the velocity of the coarse particles proportional to solids size and density.
2. Solids velocity was dependent upon the material physical characteristics and independent of pipe diameter and solids flow rate.
3. Prediction equations were developed that are valid for flow conditions where the solids air ratios were less than or equal to two.

Project No. MD-R-35
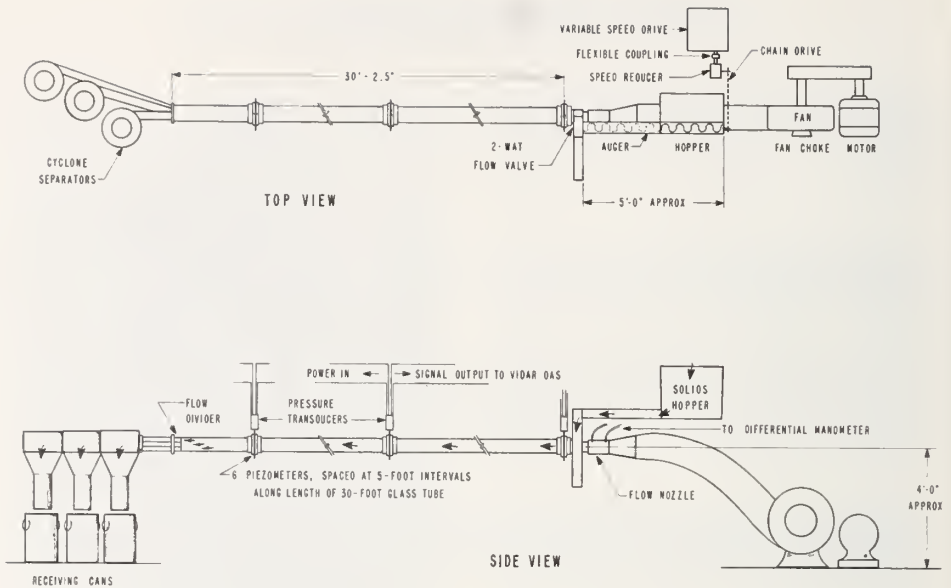
A Schematic Of The Test Apparatus Used To Study The Characteristics Of Pneumatic Conveying Of Mixed Granular Material.

DEVELOPMENT OF THE MODULUS OF ELASTICITY
OF FIBROUS REINFORCED CONCRETE

A composite structural material is two or more materials combined to produce a new material. The new material generally has properties significantly different from those of its base material. Before new composite materials can be employed in building designs, qualitative specifications need to be developed.

The purpose of this project was to study how the modulus of elasticity of a fiber reinforced composite varies as a function of the fiber variables; namely, fiber length, fiber diameter, percent fiber and the modulus of elasticity of the matrix and the composite. Dimensional analysis was selected as the basis for designing the experiment and analyzing the data.

Prediction equations involving the pertinent variables listed were developed for the test specimens under tensile, compressive and bending loads. Statistical analysis indicated that the relationship between the data and the prediction equation was highly significant and that most of the variation in the data was accounted for by the prediction equation.

Project No. MD-R-36

EXTENDED AERATION TREATMENT OF TOMATO WASTES

Extended aeration plants have operated very successfully in the treatment of domestic sewage and are capable of reducing the BOD levels by 90-95 percent. Very little work has been done with this system in conjunction with treating vegetable wastes. As a result, little or no design parameters are available to the consulting engineer.

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The purpose of this experiment was to investigate whether tomato cannery wastes could be effectively treated by the extended aeration process and if so, to establish the parameters required for the design of such systems.

A bench model was designed to treat approximately one-thousandth of the flow expected from a typical small cannery. The size of the plant selected had an average flow rate of 60 gallons per minute, operated for an eight hour period for five days each week, and discharged an effluent with a strength of approximately 1,500 ppm BOD. (Figure 5)

1. Settling Tank
2. Overflow Weirs
3. Aeration Tank
4. Re-circulation Pump
5. Return Line
6. Rotometer
7. Air Lines
8. Diffusers
9. Influent
10. Effluent
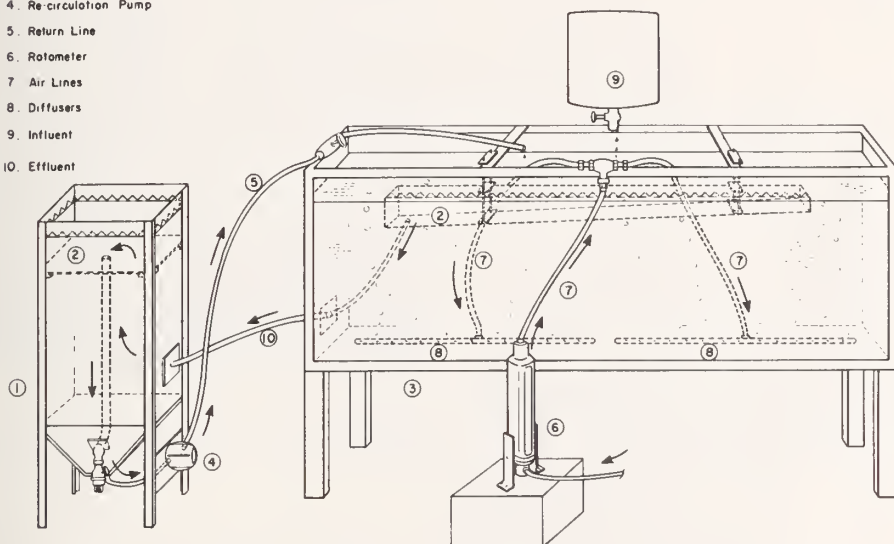
MODEL PLANT OF AN EXTENDED AERATION SYSTEM

The results of the experiment indicate that the extended aeration process can be used to effectively treat tomato waste from a cannery operation. An analysis of the data indicated that:

1. The BOD removal rates range from 80 to 90 percent of the strength of raw sewage.
2. Suspended and volatile suspended solids are removed at a rate ranging from 85 to 98 percent of the raw liquid wastes.
3. Sufficient amounts of nitrogen and phosphorous are present to supply sufficient nutrients for proper bacterial growth.
4. A system to handle wastes from a tomato cannery can be designed according to the rational design criteria method.

Project No. MD-R-37

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PREVENTION OF CROP DAMAGE BY DEER

The use of booby traps made from M-80 firecrackers with trip wires have been found the most successful method to prevent crop damage by deer. However, due to danger of a human tampering and injury occurring, these devices are not recommended.

This project has as its objective to develop a booby trap that would frighten deer and not be harmful to humans. Several mechanisms were designed and constructed to fire 22 caliber blanks. These were so constructed that conventional 22 cartridges could not be fired. The design finally used was a brass block that was spring loaded and mounted on one-inch angle iron such that when tripped the block rotated with cartridge striking the angle and firing. Fifty of these units were made. The Wheaton Nature Center was experiencing serious deer damage to prize azaleas in their Botanical Garden. The deer were coming in at night to browse heavily on these bushes and the park was unable to prevent this. The traps were placed in the garden with trip wires to detonate the traps. Some traps were detonated by the deer on the first and second nights. After that no more were set off by the deer. Damage to azaleas ceased after the first night. After one month the traps were removed.

Booby trap with trip wire in apple orchard. Note wire cage around each tree to prevent deer damage.

Project No. MD-R-38

DEVICE TO MECHANICALLY TRANSFER BIRDS

A prototype machine was designed and constructed to mechanically transfer birds from the defeathering line to the eviscerating line. This device would eliminate the need to re-hang the birds after their shanks are removed as is currently practiced.

The refinement of this machine could have a considerable impact on the operational costs incurred in a poultry processing plant. It would also serve as an example for other areas that could be mechanized.

Project No. MD-R-39

PILOT STUDY OF A MECHANIZED COMPOSTING SYSTEM FOR AGRICULTURAL WASTES

A pilot study composting system for the 80-cow dairy herd on the College Park Campus has been designed and is under construction. This system will be semi-automated, requiring small expenditures of labor and time. The composting channel, which is eight feet wide, five feet high and 64 feet long, will allow approximately 15 days residence of the waste. The partially composted material will then be moved into a programmed window storage area for an additional 15-20 days where composting will be completed.

Project No. MD-RG-40

CHLORINATION OF LIVESTOCK WASTE EFFLUENT

The objective of this project is to determine the parameters required for effectively disinfecting effluent from livestock operations by means of chlorination.

Bench studies are being conducted to determine the effect of chlorination (concentration and detention time) on coliform infested waters as a function of alkalinity, pH, temperature, BOD, solids and nutrients.

A chlorinating system will be set up on an existing farm pond to determine if data collected in the bench studies are applicable to field conditions.

Project No. MD-R-41

NUMERICAL AND FIELD EVALUATION
OF UNCONFINED FLOW TO A SINGLE WELL

Project activity encompassed three subject areas: aquifer test, numerical simulation model and aquifer analysis by digital computer. During the first year, significant progress was achieved in adapting conventional techniques of aquifer analysis to solution by the digital computer.

The location of a suitable site for the aquifer test has proceeded at a slower pace than anticipated. In effect, no site has yet been located. Relative to the aquifer test, the Maryland Department of Natural Resources has offered to assist in developing observation wells for use in the test. Some of the instrumentation for the test has been designed, although the purchase and installation of such must await the location of a test site.

One major modification of the numerical, finite difference model has been completed. With the model's present formulation, the points of truncation of the aquifer can be handled as either no flow boundaries or as constant head boundaries. The boundary treatment based on the concept of constant hydraulic head provides a more stable numerical scheme. The no flow approach, although more valid from a theoretical perspective, poses some difficulty relative to the numerical scheme. Additional investigation will aid in defining the significance of the two boundary treatments and in essence depict the relative loss in accuracy which might be associated with the constant head boundary approach.

Project No. MD-R-42

CURING OF MARYLAND TOBACCO

There are two objectives for this project. One is to determine if Maryland tobacco can be cured detached from the stalk without affecting the quality, and the other is to determine the effect of growth regulators on curing rates and quality of Maryland tobacco.

Tobacco will be cured two ways, on the stalk and leaves removed when mature and bulk cured. Plants will be field treated with ethylene releasing growth regulators and cured on stalk and leaves removed. Degree of yellowing will determine when leaves are detached. Curing requirements for detached leaves will be determined.

Project No. MD-R-43

CENTRIFUGAL FERTILIZER DISTRIBUTOR DESIGN
FOR CONTROLLED DISTRIBUTION PATTERNS

The objectives of this project are: (1) To develop mathematical equations representing the motion of a particle on several centrifugal distributor configurations which may minimize the problem of impact and bounce; (2) To solve by electronic analog computer, these equations of motion; (3) To establish the optimum design; and (4) To experimentally verify the theoretical results of this design in the laboratory.

A mathematical analysis of several blade configurations has been made. Each configuration was analyzed using the electronic analog computer. Using the results obtained from each configuration, i.e. angle of departure and exit velocity, the configuration which maximized the two parameters above and minimized material-to-blade impact and bounce was constructed and tested. The theoretical results are being verified using high speed photography.

Project No. MD-R-44

ENGINEERING ASPECTS OF CLOSED CYCLE SYSTEMS
FOR PRODUCTION OF FIN AND SHELLFISH

The objective of this project is to determine the physical parameters of temperature, water quality, feed, disease control, light, stocking density and waste disposal required in the operation of a closed cycle system for optimum production of fin and shell fish.

Studies are being conducted on fresh and salt water systems using 300 to 500 gallon closed cycle systems. Parameters monitored are temperature; pH; oxygen; feed requirements; chlorine and other chemical elements. Different methods to effectively remove waste, both solid and nutrients, from the system are being stressed as good water quality is necessary for a closed system.

Project No. MD-R-45

EVALUATION OF ORGANIC ACIDS AS
PRESERVATIVES FOR STORED FORAGES

Use of organic acids is now a practical alternative method for preservation of high moisture corn. Limited experiments show that a preservative effect also exists in forages. The project objectives are: to determine extent of preservation, chemical characteristics, heating and browning, or animal acceptance, nutritive and production value of treated forages as a function of application rate in critical moisture ranges; to solve application, storage, and handling problems which may be associated with the acids; and to provide the data and analytical procedures for comparison with other methods of forage preservation.

Several acids applied at different rates to alfalfa and other forages in a factorial arrangement treating moisture content and methods of handling and storage as major variables will yield samples to be analyzed for various quality indicators. Experimental application equipment and storage systems will be used for larger scale evaluation of promising techniques. A systems analysis will determine necessary input data for use of the NE-70 forage model. Feeding trials will be conducted with sheep and heifers with feeding activity monitored. Measurement of digestiability by standard techniques will be compared with in vitro dry matter disappearance. Open circuit calorimetry will be used to determine energy balance. Dairy production measurements will be made after appropriate treatments are established.

Project No. MD-ROG-46

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